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Mission Statement for TRMM Release for the ECS Project

White paper - Not intended for formal review or Government approval.

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Abstract

This white paper defines the scope of TRMM Release with an ephasis on development and integration. It is expected to serve as a concise guide, primarily for the ECS staff who are developing and integrating the TRMM Release. It is not a formal deliverable and is not subject to government review or approval.

The ECS TRMM Release System will be deployed December 1996 at four of the Distributed Active Archive Centers (DAACs)—GSFC, EDC, MSFC and LaRC. It will be the first operational release of the ECS capability for all but EDC which will employ the system for interface testing. The TRMM Release has two primary objectives: (1) comprehensive data processing of the TRMM data for CERES and LIS instruments (at LaRC and MSFC respectively) through L4 product generation and distribution, receipt, archive and distribution of TRMM data products received from TSDIS; and (2) full ground operations support for TRMM including regridding of ancillary data, algorithm ingest, execution and test support, data access and associated client and data management services. Secondary objectives for the TRMM Release consist of the following: support for the access of V0 data migrated in the TRMM Release time frame; early interface testing support for Landsat-7; and early interface testing support for EOS AM-1. The Flight Operations Segment (FOS) and the Data Assimilation Office (DAO) interaces are also tested.

Keywords: TRMM, release, development, integration, DAAC, CERES, LIS, operations, data

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Contents

Abstract

1. Summary

1.1 Purpose 1-1

1.2 Primary Objectives 1-1

1.3 Secondary Objectives 1-1

1.4 Review and Approval 1-2

2. Capabilities of TRMM Release

2.1 TRMM Operational Data Processing Support 2-1

2.2 Early Landsat-7 Interface Testing 2-2

2.3 Early EOS AM-1 Interface Testing 2-2

3. External Interfaces

3.1 Interfaces Implemented in Ir-1 3-1

3.2 Interfaces Implemented in TRMM Release 3-1

3.3 Interfaces Implemented to Facilitate Early EOS AM-1/Landsat 7 Release Testing 3-3

4. Science Software Integration and Test (SSI&T)

4.1 Goals of SSI&T 4-1

4.2 SSI&T Procedures 4-1

4.3 Schedule and Expected State of SDP Software Development 4-2

4.4 SSI&T Tools 4-3

5. Version 0 and ECS TRMM Release

5.1 Data Migration 5-1
5.2 TRMM Release Interoperability with V0 5-2
5.3 TRMM Release Reuse of the V0 Client Software 5-2

6. TRMM Release System Configuration

6.1 TRMM Release Architecture by DAAC 6-1
6.1.1 ECS TRMM Release Configurations by Site 6-1
6.1.2 Network Implementation and Management 6-1
6.1.2 Network Implementation and Management (continued) 6-7
6.2 DAAC and SMC/ESN Hours of Operation 6-9

7. Transition from Ir-1 to TRMM Release

7.1 TRMM Release Development and Integration Approach 7-1
7.2 Transition of Ir-1 Based SSI&T to TRMM Release 7-1
7.3 Ir-1 Software Enhancement and Bug Fixes 7-2
7.4 TRMM Release Hardware Delivery to DAACs 7-2
7.5 TRMM Release Post-RRR Testing and Transition to Operations 7-3

8. Transition from TRMM Release to

8.1 TRMM Release Development Approach 8-1
8.2 Concurrent Support of TRMM Release Operations and 8-1
8.3 TRMM Release Software Enhancement and Bug Fixes 8-2

9. TRMM Release Implementation Strategy

9.1 TRMM Release Implementation Planning Objectives 9-1
9.2 TRMM Release Implementation Phases and Schedules 9-1
9.3 TRMM Release Deployment 9-2

Figures

3.2-1. TRMM Mission Key Interfaces 3-2

3.3-1. Landsat-7 and AM-1 Key Interfaces 3-4

6.1.1-1. GSFC DAAC H/W and COTS S/W Configurations 6-2

6.1.1-2. LaRC H/W and COTS S/W Configurations 6-3

6.1.1-3. MSFC H/W and COTS S/W Configurations 6-4

6.1.1-4. EDC H/W and COTS S/W Configurations 6-5

6.1.1-5. SMC and EOC H/W and COTS S/W Configurations 6-6

9.2-1. Release A Schedule 9-3

Tables

4-1. TRMM Instrument SDP Software Deliveries for TRMM Release 4-2

4-2. AM-1 Instrument SDP Software Deliveries for TRMM Release 4-3

4-3. SSI&T Tool Capabilities 4-4

5-1. V0 Data Sets to be Migrated under ECS TRMM Release 5-1

6-1. Hours of Staffed Operations 6-9

Appendix A. TRMM Release Capabilities

Abbreviations and Acronyms

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1. Summary

1.1 Purpose

This White Paper discusses the ECS TRMM Release System to be deployed December 1996 at four of the Distributed Active Archive Centers (DAACs) - GSFC, EDC, MSFC and LaRC.

1.2 Primary Objectives

The TRMM Release System has the following primary objective:

TRMM Operational Data Processing Support. With the initial staging of the ECS environment accomplished in Ir-1, the TRMM Release provides full ground operations capability for the ingest and archival of TRMM data received from Sensor Data Processing Facility (SDPF). It supports L1 through L4 product generation for CERES and LIS instruments and receipt, archival and distribution of TRMM data products. The TRMM Release provides access to metadata, generated during L1 through L4 product generation at the DAACs, and ingest, archival and distribution of data products received from TSDIS.

The CERES product generation capabilities are provided at the LaRC, while LIS capabilities are provided at the MSFC. Additionally, both MSFC and GSFC provide archive capabilities for ancillary data and L1 through L4 data. The System Monitoring and Coordination (SMC) center, located at the GSFC, monitors and coordinates the operational sites. TRMM Release is deployed at EDC for continued Science Software Integration and Test (SSI&T) and interface testing.

1.3 Secondary Objectives

The TRMM Release System has the following secondary objectives:

- **Early Landsat-7 Interface Testing**

  TRMM Release provides capabilities for early functional testing of Landsat-7 ground system interfaces among several facilities including the Landsat Processing System, NOAA/NESDIS, the Data Assimilation Office (DAO), and three DAACs: LaRC, GSFC, and EDC.

- **Early EOS AM-1 Interface Testing**

  TRMM Release provides capabilities for early functional testing of EOS AM-1 ground system interfaces among several facilities including the Flight Dynamics Facility (FDF), the Aster Ground Data System (AGDS), NOAA/NESDIS, the DAO, the ECS Data Operation System (EDOS), and three DAACs: LaRC, GSFC, and EDC. EOC to EDOS and FOS interfaces are also exercised.

1.4 Review and Approval

This Paper is not a formal deliverable and is not subject to government review or approval. It is intended as a guide mainly for the TRMM Release development team members and other ECS groups.

Questions concerning distribution or control of this document should be addressed to:

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2. Capabilities of TRMM Release

2.1 TRMM Operational Data Processing Support

TRMM Release provides an operational environment to support TRMM operations at the DAACs. In addition to all TRMM-required external interface capabilities, TRMM Release implements external interfaces which support Landsat-7 and EOS AM-1 early interface testing.

TRMM Release supports the integration of launch-ready Science Data Production (SDP) software for CERES and LIS instruments. It supports the integration of versions of the SDP software for AM-1 instruments (ASTER, MISR, MODIS and MOPITT), and also for SAGE III.

TRMM Release subsumes its predecessor, the Ir-1 (infrastructure) baseline, which is a subset of the TRMM-required capabilities. Components which in Ir-1 provide a simulated functionality using prototype software are replaced in TRMM Release.

The following is a delineation of the TRMM Release capabilities. Appendix A provides a detailed description of TRMM Release capabilities.

Ingest: The capability to ingest data from a network or hard media source for any TRMM Release interface; convert/reformat data, extract and check metadata, transfer data, and process data requests; and provide history logging, request statusing, request cancellation; and a GUI for the DAAC Operator.

Data Server: Core data server capabilities which include archival/retrieval (file and record-based) of TRMM Release and migrated V0 data, request handling, monitoring, archive and DBMS management, performance monitoring, resource control, operator deletion of requests in the Data Server, logging, subscriptions and electronic distribution.

Interoperability: Capabilities for interactive browsing, searching and submission of advertisements and subscriptions. Advertisements are moderated through group moderators for authorized advertisement groups

Communications: Authenticated/authorized access to computing resources via electronic service calls; support for development of distributed applications in a heterogeneous, open-system, location-transparent environment; and interprocess messaging.

TRMM Release Client: The GUI for accessing ECS services consisting of the Desktop (for management of desktop objects in the user's local file space) and the Workbench (for support of V0 Client modifications, integration and testing). ECS will incorporate the V0 client for the TRMM Release.

Data Management: The interface between the TRMM Release Client and the ECS Data Servers is comprised of two components, a Data Dictionary Service (DDS) which will provide translation from the ECS Data Server terms and definitions to the V0 list of values, and a V0 Gateway which will provide V0 to ECS Data Server protocol translation.

Science Data Production Planning and Scheduling: The capability for science data product generation according to pre-defined rules of candidate and alternative plans/schedules for the production processing/reprocessing of ECS data such that resource utilization is optimized; this includes the planning and processing GUIs for DAACs and limited GUI capabilities, such as view of the activated plan, for remote users.

Operations Management: A set of local services including user registration, performance and reliability monitoring, resource management; and tools for software, hardware and document CM, office automation, data base management, and trouble reporting/resolution.

Inter networking: LANs at all ECS TRMM Release sites, and interfaces to the EOSDIS Backbone network (EBnet subsumes what was formerly the EOSDIS science network, and Ecom), NASA Science Internet, and ECS TRMM Release site campus LANs.

System Management Services: The enterprise management services supporting monitoring and management of networking, system and application resources.

2.2 Early Landsat-7 Interface Testing

TRMM Release provides capabilities for supporting Landsat-7 ingest interface testing. Exercising the TRMM Release ingest interface performs format verification on incoming data. The system supports the testing of the Landsat Processing System (LPS) interface with the ECS which includes the exchange of security authentication messages.

2.3 Early EOS AM-1 Interface Testing

TRMM Release provides the capability for supporting AM-1 ingest interface testing. The system supports the testing of the Aster Ground Data System (ASTER GDS) interface with the EDC DAAC. This testing includes the exchange of security authentication messages. TRMM Release supports the testing of the EDOS MODIS L0 interface with the GSFC and LaRC DAACs, and the ECS interface with the DAO.

3. External Interfaces

TRMM Release will add functionality to the external interfaces implemented in Ir-1, and implement some new interfaces. The following paragraphs provide details.

3.1 Interfaces Implemented in Ir-1

TRMM Release will reuse the interfaces implemented by Ir-1 which are:

- SDPF with ECS
- TRMM Science Data and Information System (TSDIS) with ECS
- DAO with ECS
- National Environmental Satellite Data and Information Service (NESDIS) with ECS
- ECS Development Facility (EDF) with GSFC, LaRC, MSFC and EDF Data Active Archive Centers (DAACs)

3.2 Interfaces Implemented in TRMM Release

Interfaces which will be implemented in the TRMM Release are presented in Figure 3.2-1, TRMM Key Interfaces. These interfaces include those from Ir-1 with the addition of the following:

- interfaces for operational TRMM testing support
- user access to data, browse, and TRMM products
- V0 data migration and interoperability
- interfaces for AM-1/Landsat 7 early testing support
- TSDIS access to PR and TMI data for reprocessing, Special Sensor for Microwave Imaging (SSM/I) data, and Global Precipitation Climatology Project (GPCP) data
- CERES and LIS Science Computing Facility (SCF) access to data for QA

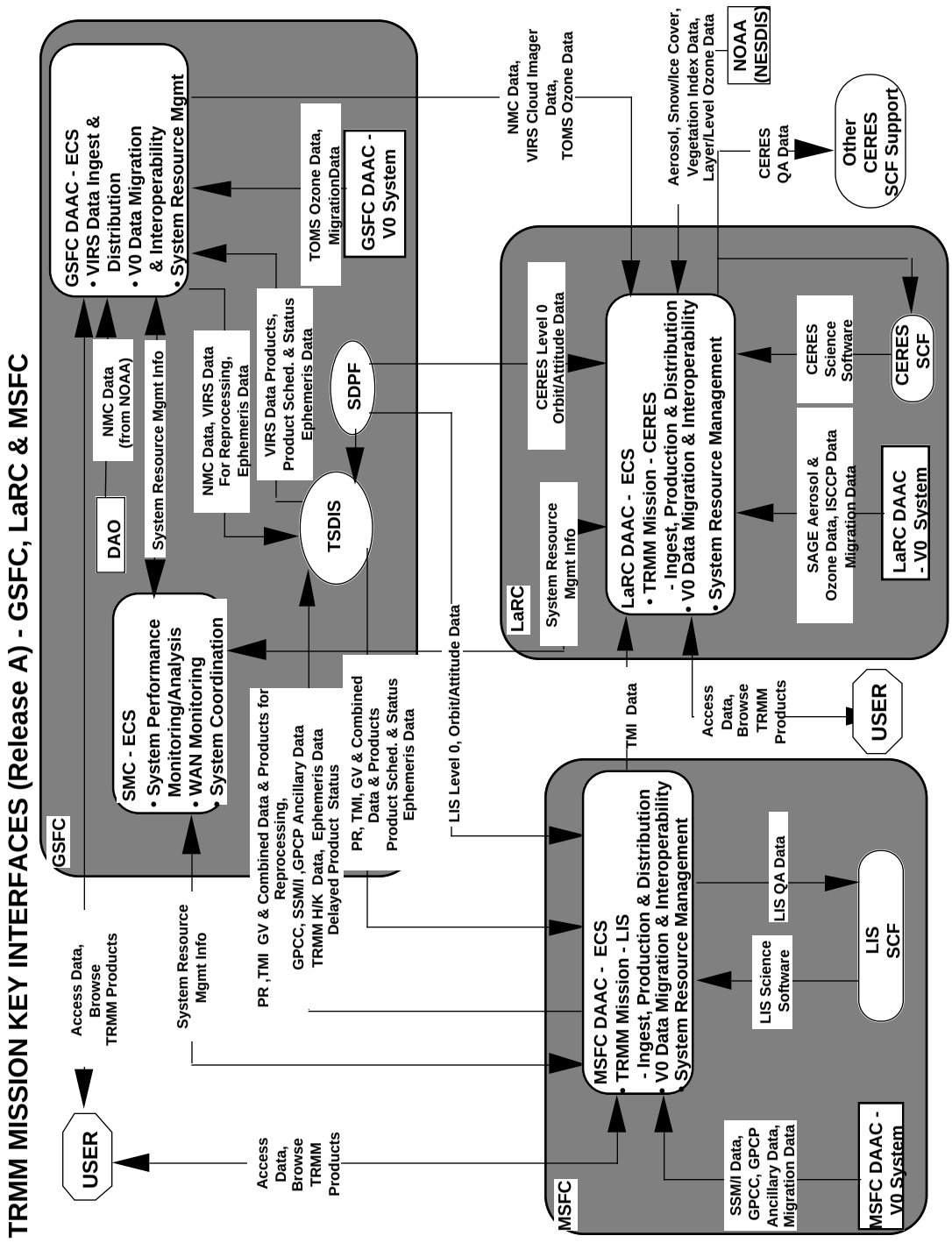

Figure 3.2-1. TRMM Mission Key Interfaces

3.3 Interfaces Implemented to Facilitate Early EOS AM-1/Landsat 7 Release Testing

The TRMM Release will implement, for early interface testing, the operational interfaces which support the AM-1 instruments and Landsat 7, as presented in Figure 3.3-1. These interfaces include those from Ir-1 and TRMM Release with the addition of the following:

- ASTER Level 1 data from ASTER Ground Data System (GDS)
- MODIS SCF Science Software and test interface with EDC
- Level 0 Release (L0R) data from the Landsat Processing System
- Ancillary data interfaces
- EDOS-related interfaces (e.g., EOSDIS Test System or ETS)
- DAO

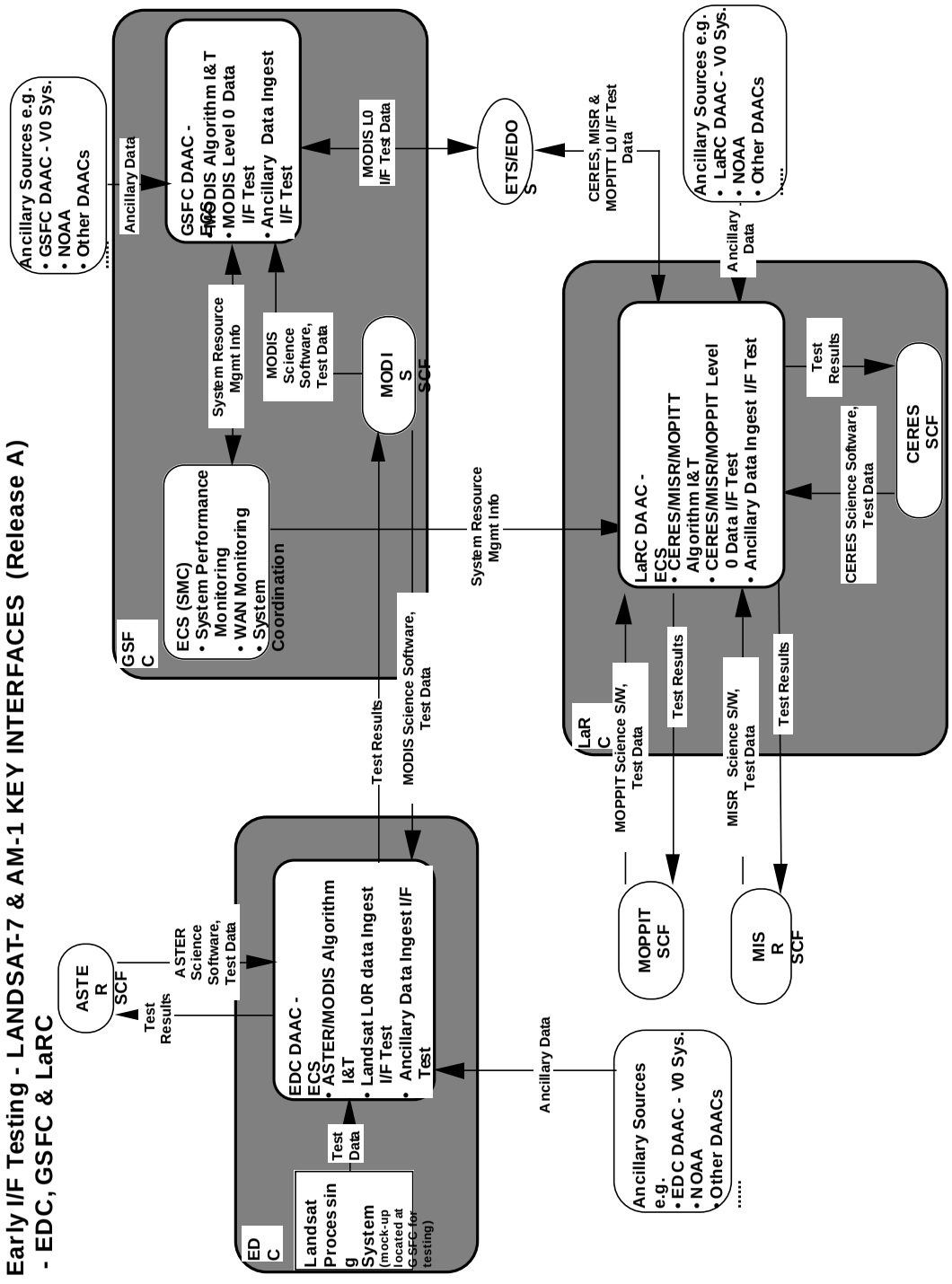

Figure 3.3-1. Landsat-7 and AM-1 Key Interfaces

4. Science Software Integration and Test (SSI&T)

ECS is responsible for providing tools and scripts to facilitate the Science Software Integration and Test (SSI&T).

4.1 Goals of SSI&T

Because the science data production software (SDP Software) is developed independently of ECS at other facilities (Science Computing Facilities, or SCFs), which may employ different computing hardware and different operating systems, the SSI&T process is mandated. The principal goals of the Integration and Test (I&T) of the SDP Software, to be achieved in the TRMM Release, are to integrate the software within a production environment, to test its ability to run to normal completion repeatedly over the normal range of data inputs and run-time conditions, and to ensure that the SDP Software executes without interfering with other software executing at the DAAC, or with DAAC operations. SSI&T will be performed at each DAAC responsible for its respective product generation.

Subordinate goals of SSI&T include

- Refining the process to arrive at efficient and effective procedures, reviews, organizational responsibilities, support and use of tools (Ir-1 and later ECS releases).
- Demonstrating the portability of the SDP Software through the adherence to standards and the use of the SDP Toolkit (Ir-1 and later ECS releases).
- Determining the production resource requirements for the SDP Software such as CPU time, RAM, and temporary storage (ECS TRMM Release and later).
- Testing of SDP Software interfaces external to the DAAC such as communications, log files and QA data with the SCF. Another important interface is the input of ancillary data to the SDP Software (ECS TRMM Release and later).

4.2 SSI&T Procedures

In general, the SDP Software is developed by an Instrument Team (IT) or other investigator at their own Science Computing Facility (SCF) to be run at a DAAC. The SDP Software will eventually need to be transferred to the DAAC and undergo the SSI&T process before being placed into production. The detailed steps will vary from DAAC to DAAC, and will most likely be specifically tailored to the science software. The following steps, however, will be performed as part of any SSI&T efforts:

a. **The IT and DAAC will coordinate the SSI&T schedule** to ensure that adequate staff and system resources are available to support the delivery of the science software.

b. **The IT transfers the SDP Software and associated materials to the DAAC.** The Instrument Teams (ITs) deliver their source code, coefficient files, test data, and documentation to the DAAC.

c. **The SDP Software is placed under SSI&T software configuration management after the software delivery to the DAAC.** This is necessary to maintain traceability between what was delivered and any changes made to the software during the SSI&T process.

d. **The SDP Software must be compiled and linked with the DAAC version of the DP Toolkit.** The DAAC version of the SDP Toolkit contains actual links with the ECS processing software which were only "stubs" in the Toolkit version available to the SCF. The calling sequences are identical between the DAAC and SCF tool kit versions, however.

e. **Standalone test cases will be run employing the suite of test data provided by the IT.** This step verifies that the output of the science software at the DAAC is the same as that obtained at the SCF. Resource usage is measured during these tests.

f. **The SDP Software information is entered into the Planning Data Base**. This information includes Product Generation Executive (PGE) identifier and version number, input and ancillary data dependencies, activation rules, and the resource profile.

g. **Operational testing will be performed**. Prior to launch, simulated data supplied by the IT will be used. For post-launch deliveries of SDP Software upgrades, a period of testing in parallel with the current production version will be performed.

Steps a) through e) will have been performed for SDP Software tested with Ir-1. Steps f) and g) are introduced as part of the SSI&T process concurrent with the ECS TRMM Release.

4.3 Schedule and Expected State of SDP Software Development

The CERES and LIS instruments are to be flown on the TRMM spacecraft, and product generation using the observed data from these instruments is to begin under ECS TRMM Release. The ITs will deliver test data for pre-launch testing. The expected status for delivery of the SDP Software of these instruments is summarized in Table 4-1.

Table 4-1. TRMM Instrument SDP Software Deliveries for TRMM Release

Instrument	SSI&T DAAC Site	Status of Science Software at TRMM Release
CERES	LaRC	The CERES IT will have the Release 2 of their SDP Software, with the SDP Toolkit fully integrated into their software—including Hierarchical Data Format (HDF), and extensive error and exception handling. Pre-launch testing will employ two month's worth of test data (each data set 17 GB in size).

LIS	MSFC	The LIS IT expects to have their program for the generation of Level 1-3 Standard Products essentially done by the Ir-1 Delivery. Therefore, their Version 2 Software will be fairly "operationally robust". Simulated Level 0 data will be based on raw data from the Optical Transient Detector (OTD) Instrument, an engineering prototype of LIS, flown earlier.

In addition to SSI&T of the launch-ready versions of the SDP Software for the instruments on the TRMM spacecraft, SSI&T will be performed for the “engineering” version deliveries of SDP Software for the instruments of the EOS AM-1 mission. The expected status for delivery of the SDP Software of these instruments is summarized in Table 4-2.

Table 4-2. AM-1 Instrument SDP Software Deliveries for TRMM Release

Instrument	DAAC	Status of Science Software at TRMM Release
ASTER	EDC	The ASTER Version 1 delivery will have all of their Level 2 Modules ready at Version 1, and include HDF, extensive error handling and most of the interfaces to external data sets..
MISR	LaRC	The MISR Team's Version 1 delivery will consist of the overall structure of the MISR processing system, and the individual PGE elements which work within the overall shell, including error handling and EOS-HDF.
MODIS	GSFC, EDC	MODIS Team will have integrated software for generating Level 1, 2 and 3 products with their Version 1 delivery.
MOPITT	LaRC	MOPITT Team will have all of their Level 2 Software ready with their Version 1 delivery. They will have simulated MOPITT data (aircraft sensor data), and they will also have ancillary data (e.g., NMC analysis data).

In addition to the above, the SAGE III instrument, to be flown on a METEOR spacecraft shortly after the launch of AM-1, will have a Version 1 delivery to the LaRC DAAC for SSI&T. The details of this are yet to be developed as of the time of this publication.

4.4 SSI&T Tools

SSI&T is a manually intensive process. Many tools will be provided, however, to assist in performing the SSI&T steps.

Although many of the needed capabilities (see Table 4-3) will have already been provided by Ir-1, it will be necessary to revisit the tool selections prior to the fielding of the TRMM Release. At the time COTS tool selections were made for Ir-1, the hardware vendors' transition from a 32 bit processing hardware architecture to 64 bits was not complete and so no third-party COTS products were available. Consequently, heavy reliance for the Ir-1 selections was made on the

tools provided by the selected hardware vendors. By the time of TRMM Release, additional, third-party COTS products should be available for 64-bit hardware platforms.

Table 4-3. SSI&T Tool Capabilities

Service	User Capability Enabled by Tools	Release First Provided
Data Ingest	receive science software delivery	TRMM
Management	configuration manage delivered science software	Ir-1
	problem tracking	TRMM
Data Processing	examine delivery for completeness	Ir-1
	check for compliance to standards	Ir-1,TRMM
	compile and link delivered source files	Ir-1
	run test cases	Ir-1
	examine test outputs, including metadata	Ir-1,TRMM
	detect errors	Ir-1
	collect resource requirements statistics	Ir-1
	update system databases	TRMM
	write reports and maintain logs	Ir-1
	write additional ad hoc tools; e.g., queries, data displays	Ir-1,TRMM

For additional details, please refer to the Mission Statement for Ir-1 White Paper for the ECS Project, Document No. 222-WP-001-001.

5. Version 0 and ECS TRMM Release

TRMM Release will be involved with three areas of the V0 System: V0 data migration, V0 interoperability, and reuse of V0 client. The following paragraphs describe the scope of these.

5.1 Data Migration

Beginning with ECS TRMM Release operations at the GSFC, LaRC and MSFC DAACs, existing high priority data sets will be migrated from their current V0 storage into ECS in order to permit the user to access these data and utilize the broader range of services that are provided by ECS. This data migration effort is expected to continue until the ECS Release C, currently scheduled for late 1999.

The V0 data scheduled for migration during TRMM Release operations, as known at this time, are listed in Table 5-1 by data set name, and expected to total approximately 2,938 GB. some of which will be migrated by the time the TRMM Release is operational.

The ECS Science Office will be responsible for data migration. The TRMM Release development staff will interact with the Science Office personnel as needed to facilitate the migration.

Table 5-1. V0 Data Sets to be Migrated under ECS TRMM Release

DAAC	Data Set
GSFC	TOMS-nimbus 7
GSFC	CZCS level 1
GSFC	AVHRR Pathfinder
LaRC	ERBE
LaRC	ISCCP D-x, D-1,D-2
LaRC	SAGE II level 2&3
MSFC	SSM/I Pathfinder
MSFC	TOVS Pathfinder
MSFC	SMMR Pathfinder

The requirements for successful Version 0 data migration include:

- Maintenance of data integrity (i.e., the science content of data is not corrupted during Version 0 migration)
- Reuse of existing ECS software and hardware where feasible
- Development of infrastructure software to generalize tasks (i.e., development of data product-specific software is minimized)

- Maintenance of operational integrity (i.e., the impact of Version 0 data migration on ongoing DAAC operations is minimized)
- Maintenance of service for migrated V0 data sets (however, product-specific subsetting is not supported in TRMM Release)

The methodology used for migrating data follows the guidelines established in the Version 0 Data Migration and Translation Tools White Paper (ECS 193-00136) dated December 1993. Further, the methodology has been refined and documented in the Version 1 Data Migration Plan (ECS 160-TP-002-001) dated January 1995.

5.2 TRMM Release Interoperability with V0

At the end of the migration of a V0 data product (data, metadata, browse, documentation, etc.) a Data Readiness Review (DRR) will be held with DAAC management and ESDIS personnel to verify the operational readiness of the data product. Until the DRR, the data product will only be available from the V0 system.

Access to V0 data utilizing the TRMM Release client is possible, however, since TRMM Release client will use an enhanced version of the V0 client in accomplishing browse, search and order functions.

Users employing the V0 client will be able to access TRMM Release data holdings via a " V0 Gateway". In this way, a gradual transition of V0 to ECS services will be provided to the user, not a turnkey switch from one to the other. Full two-way interoperability between the V0 and ECS data is provided in this manner.

5.3 TRMM Release Reuse of the V0 Client Software

Prior to the SDPS Preliminary Design Review (PDR) held in February 1995, ECS and ESDIS, with the concurrence of the user community, decided to reuse the V0 client software for TRMM Release. The V0 client software has been operational at the DAACs. The TRMM Release client will be an enhanced version of the V0 client.

For information regarding the reuse of the V0 client, please refer to the Implementation Plan for the (TRMM) Release A Client (441-TP-001-001).

6. TRMM Release System Configuration

This section describes the system configuration proposed for the TRMM Release at the various DAACs.

6.1 TRMM Release Architecture by DAAC

The nominal DAAC hardware architecture under ECS TRMM Release will include the elements indicated in Figures 6.1.1-1 through 6.1.1-4 The SMC and EOC hardware architectures are provided in Figure 6.1.1-5. Shaded portions of the charts indicate the Ir-1 re-use.

6.1.1 ECS TRMM Release Configurations by Site

Figures 6.1.1-1 through 6.1.1-5 represent the recommended configurations of hardware and a list of the commercial software by site that will be hosted on the hardware platforms for the GSFC, LaRC, MSFC and EDC DAACs and the SMC and EOC respectively. These selections provide the functionality necessary to accomplish the TRMM Release objectives. The actual sizing of the hardware components will be available by the Critical Design Review (CDR), and is based on the Ad Hoc Working Group on Production (AHWGP) data which uses the ECS Systems Performance Model.

6.1.2 Network Implementation and Management

The local area network (LAN) at the GSFC, LaRC and MSFC DAACs will consist of several FDDI rings supporting a single or multiple Science Data Processing Subsystems interconnected via a FDDI switch/router. The switch/router will be connected to both primary and secondary EOSDIS Science Network (ESN) Wide Area Network (WAN) routers that provide all external connections. It will also be connected to the V0 DAAC LAN segment. Network attached peripherals will be connected to Ethernet (10BaseT) segments (implemented using one or two low end stackable 10BaseT hubs). The switch/router will be able to perform network layer filtering for security.

The FDDI rings required to support several network attached devices will be constructed using two FDDI concentrators so that servers and high end processors can be dual attached and dual homed simultaneously. This will give redundant connections for the high end computing devices. Workstations will have single attached station connections and will be attached to either of the two concentrators. Those rings that support very few devices will be physically wired and will not be formed using concentrators.

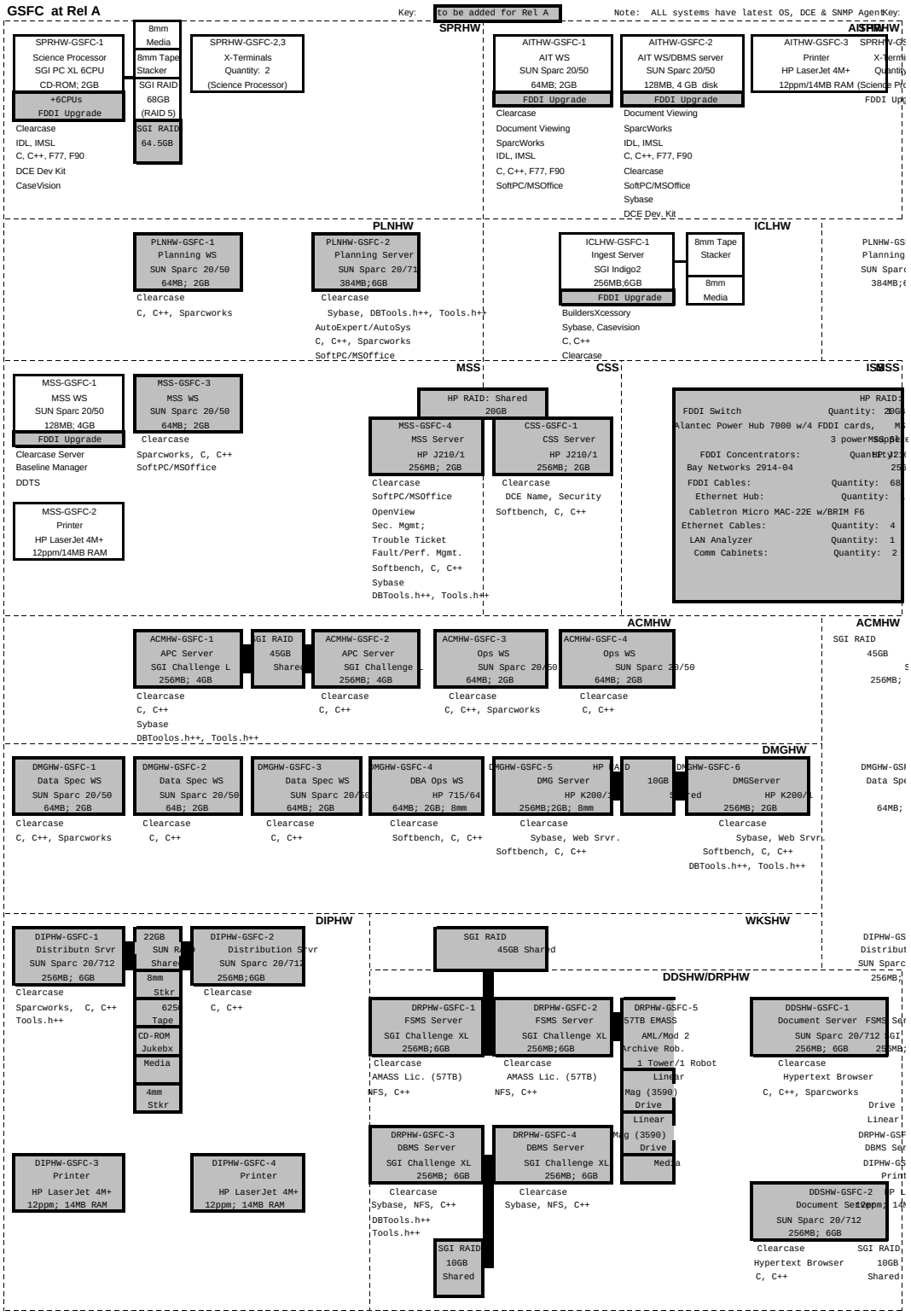

Figure 6.1.1-1. GSFC DAAC H/W and COTS S/W Configurations

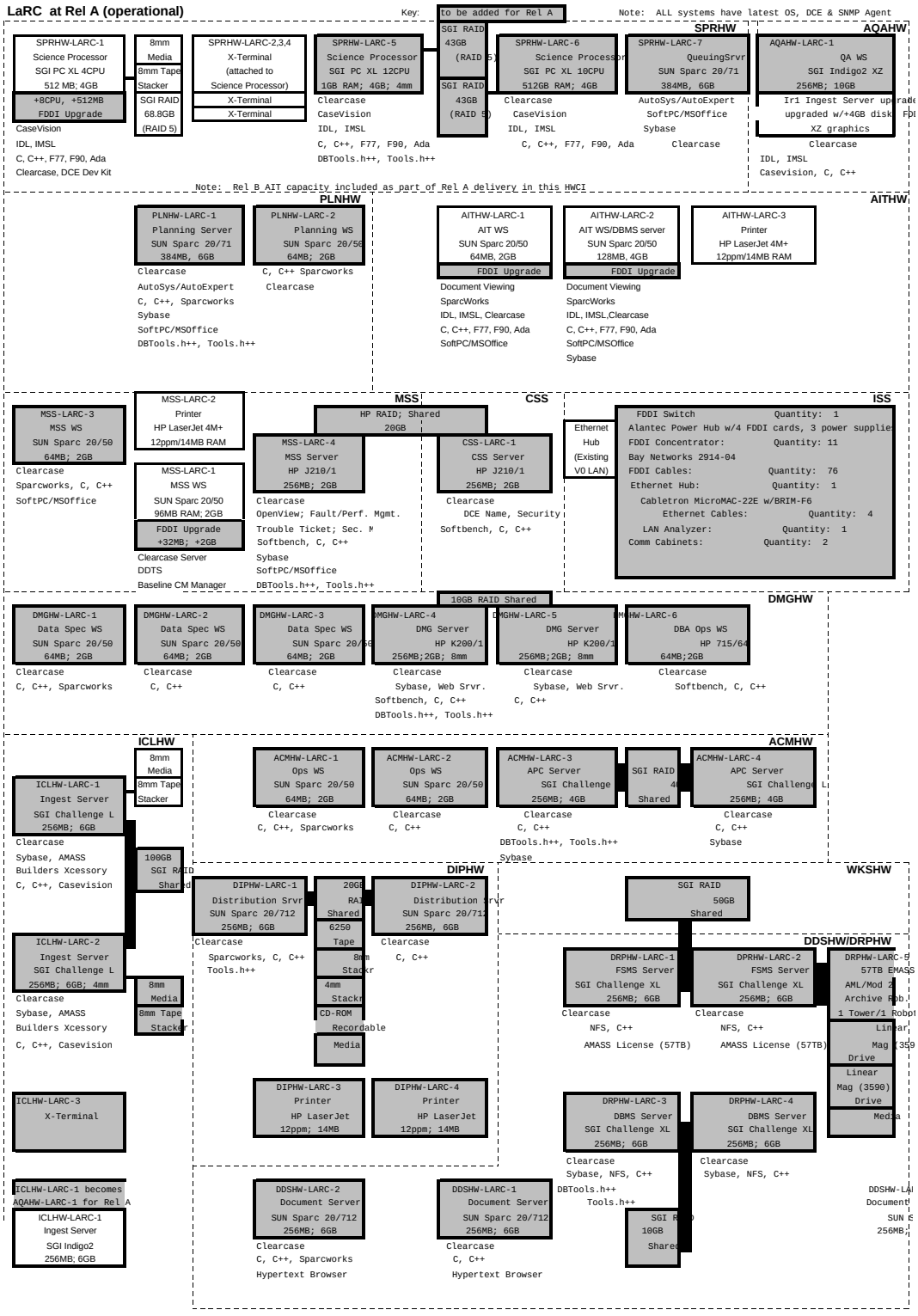

Figure 6.1.1-2. LaRC H/W and COTS S/W Configurations

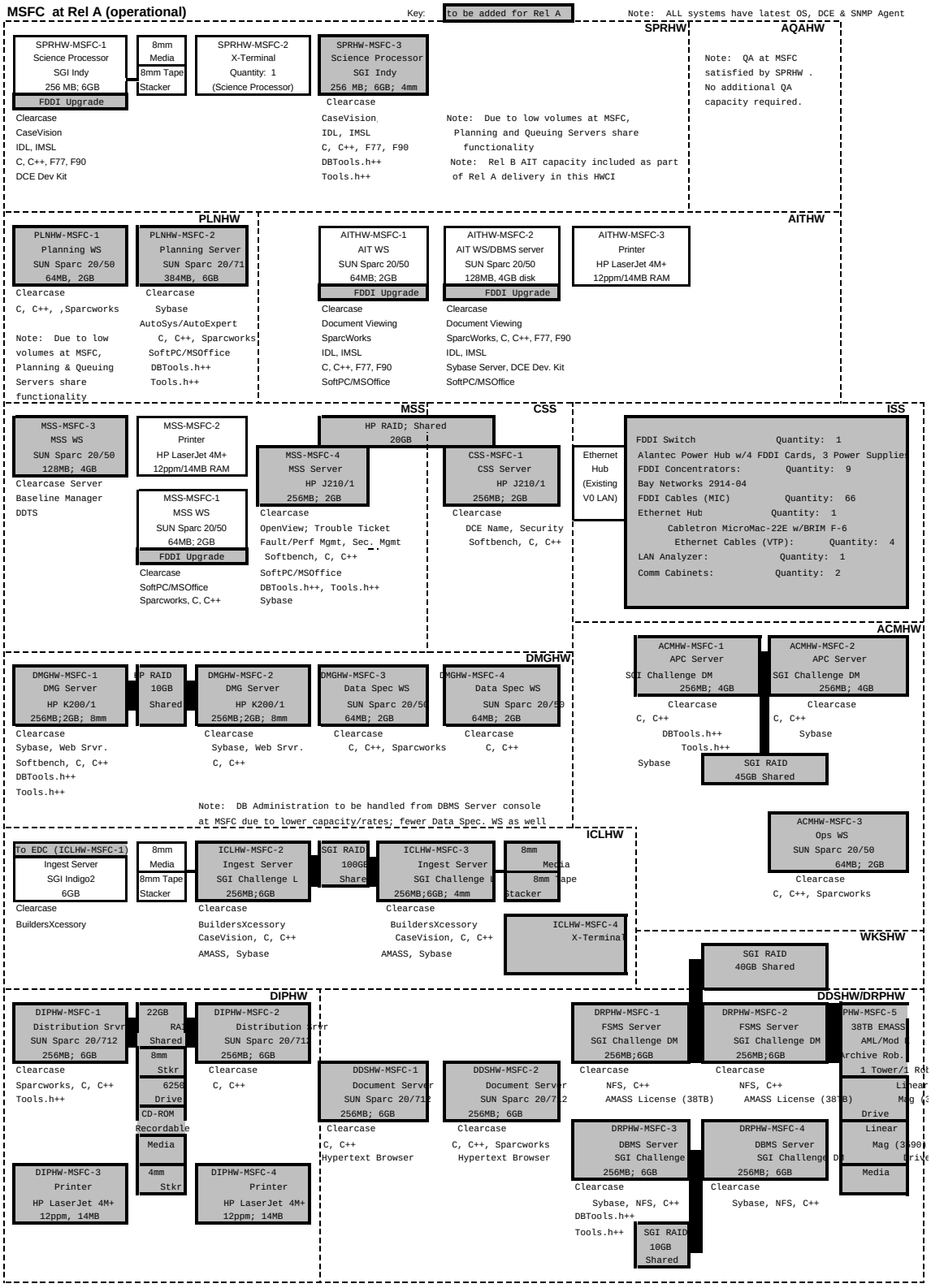

Figure 6.1.1-3. MSFC H/W and COTS S/W Configurations

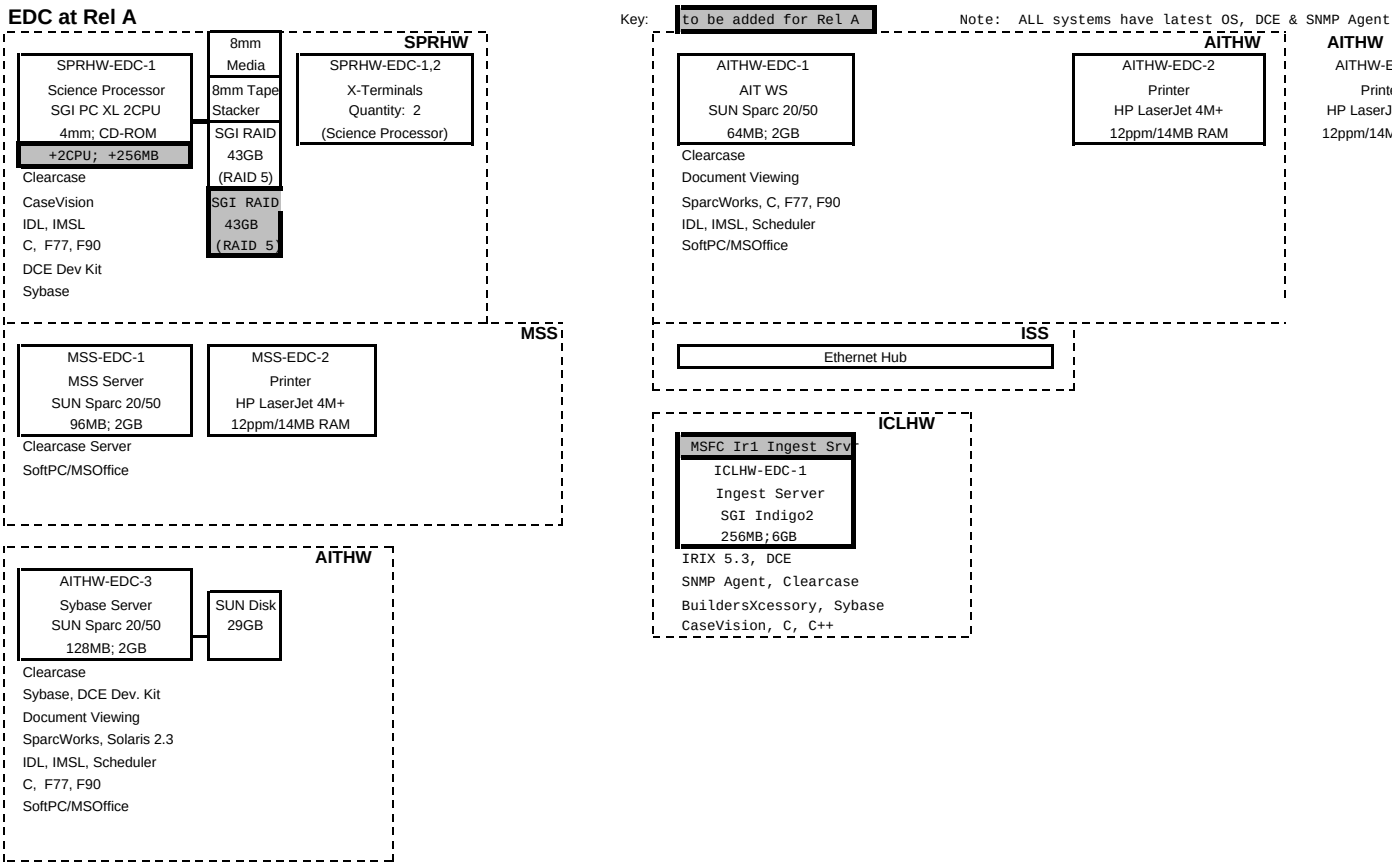

Figure 6.1.1-4. EDC H/W and COTS S/W Configurations

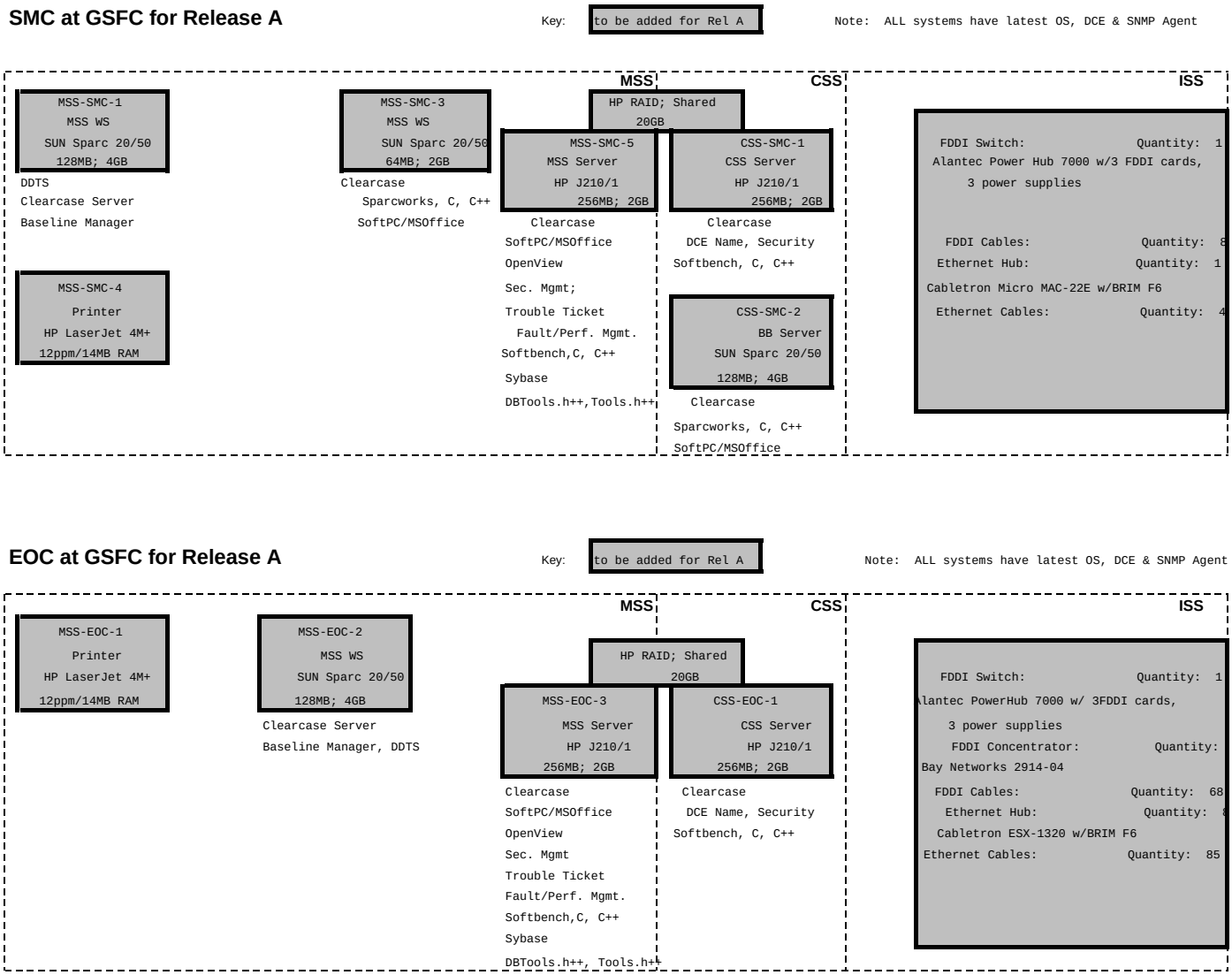

Figure 6.1.1-5. SMC and EOC H/W and COTS S/W Configurations

6.1.2 Network Implementation and Management (continued)

The networks were sized using modeling data and engineering judgment regarding expected number of attached devices, degree of user access and types of functions supported for the TRMM Release The proposed architecture is scalable and evolvable. The FDDI rings can be added or removed depending upon the particular needs of a given DAAC. Emerging or existing technology insertions can be made to meet growth and evolvability requirements.

The DAAC LANs are managed via the local system management (LSM) management servers. All network joining devices (such as concentrators and routers) will be Simple Network Management Protocol (SNMP) manageable. The LSM servers and associated workstations will be on a separate FDDI segment that is directly connected to the switch/router. This will give equal access to all parts of the DAAC network as well as the connection that leads to the SMC (EBnet routers).

6.1.2.1 GSFC DAAC Network

TRMM Release activities that are to be supported by the GSFC DAAC are:

- Archival and distribution of TSDIS data
- V0 data migration
- AM-1 ingest testing
- SSI&T for AM-1.

The TRMM Release GSFC DAAC network will consist of five FDDI segments corresponding to L0 ingest, data management, data server, processing and planning and local system management. In addition there will be FDDI interfaces supporting connections to the V0 DAAC LAN and the EBnet routers. The SMC and EOC LANs will be directly attached to the WAN routers (both FDDI interfaces). There will also be an interface to the GSFC/ESDIS V0 FDDI exchange LAN to which NASA Science Internet (NSI), TSDIS, NASCOM Operational LAN (NOLAN) and the GSFC campus network (CNE) will be connected. The SCFs and entities such as DAO will have access to the DAAC via NSI or the CNE as needed. Note that EBnet routers will directly connect to the L0 ingest segment of the DAAC LAN.

6.1.2.2 TRMM Release Network at LaRC DAAC

TRMM Release activities that are to be supported by the LaRC DAAC are:

- L0 data ingest for TRMM/CERES
- Processing for TRMM/CERES
- V0 data migration
- AM-1 ingest testing
- SSI&T for AM-1
- CERES product archival and distribution

The TRMM Release LaRC DAAC will consist of five FDDI segments corresponding to L0 ingest, data management, data server, processing and planning, and local system management. In addition there will be FDDI interfaces supporting connections to the V0 DAAC LAN and the ESN WAN routers. There will also be an interface to the LaRCNET FDDI isolation LAN to which NSI, SURAnet and LaRCNET routers are connected. The SCFs will have access to the DAAC via LaRCNET or NSI. Note that EBnet and NOLAN routers will directly connect to the L0 ingest segment of the DAAC LAN. In addition to TRMM/CERES ingest and processing there will be AM-1 related ingest testing and SSI&T activities. There will also be V0 data migration.

6.1.2.3 TRMM Release Network at MSFC DAAC

TRMM Release activities that are to be supported by the MSFC DAAC are:

- L0 data ingest for TRMM/LIS
- Processing for TRMM/LIS
- TRMM/LIS product archival and distribution
- V0 data migration
- Archival and distribution of TSDIS products

In addition to TRMM/LIS ingest and processing, V0 data migration and the archival and distribution of TSDIS products will take place at the MSFC DAAC. The DAAC network at MSFC will be able to support these activities during TRMM Release and later releases (there is no AM-1 support at MSFC). There will be a lower number of FDDI segments at MSFC compared to the GSFC and LaRC DAACs because the data server and processing subsystems will be supported by a single segment. This is due to the lower data traffic expected at MSFC and the fact that there will not be AM-1 support during EOS AM-1/Landsat 7 Release. Separate segments will support L0 ingest, data management, and local system management. In addition, FDDI ports on the switch/router will be used for connections to the V0 DAAC LAN and the EBnet WAN routers. There will also be an interface with NSI. Note that NOLAN routers will directly connect to the L0 ingest segment.

6.1.2.4 TRMM Release Network at EDC DAAC

TRMM Release activities that are to be supported by the EDC DAAC are:

- AM-1 SSI&T (ASTER)
- Ingest testing with (Landsat Processing System (LPS)

The configuration of the DAAC LAN at EDC will be identical to that of Ir-1 except for the addition of an ingest host. The activities listed above are all testing-related in nature. There is no actual production going on until EOS AM-1/Landsat 7 Release when ECS will deliver a DAAC LAN.

6.2 DAAC and SMC/ESN Hours of Operation

Beginning with the Release Readiness Review (RRR), the ECS System Monitoring and Coordination (SMC) center and the DAACs will begin operating TRMM Release. Not all shifts will be staffed at all sites, (see Table 6-1), and the TRMM Release is designed, under normal processing circumstances, to be able to continue routine data product generation and end-user data access without human intervention.

Table 6-1. Hours of Staffed Operations

Site	Staffed Shifts (RRR to TRMM Launch - 3 Mos.)	Staffed Shifts (TRMM Launch - 3 Months)
SMC/ ESN	24 hrs/day, 5 days/week	24 hrs/day, 7 days/week
GSFC	Mon 1st shift thru Sat 1st shift	Mon 1st shift thru Sat 2nd shift. Sun - 1st and 2nd shifts (i.e. no 3rd shift on weekends!)
LaRC	1st shift, Mon-Fri	1st and 2nd shift, 7 days/week
MSFC	1st shift, Mon-Fri	1st shift, 7 days/week

where the 3 shifts are currently defined as follows:

1st shift = day shift (0700 - 1530)

2nd shift = swing shift (1500 - 2330)

3rd shift = mids or midnight shift (2300 - 0730)

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7. Transition from Ir-1 to TRMM Release

The TRMM release is based on the foundation established by the Ir-1 hardware and software infrastructure. This section describes briefly how the TRMM Release is developed and integrated, how it will use Ir-1 software as a building block, what happens to the software bugs and enhancements identified during Ir-1 testing, the schedule for delivery of TRMM Release hardware, and the plan for transition to TRMM Release operations.

7.1 TRMM Release Development and Integration Approach

The objective of TRMM Release development is to utilize as much code delivered in Ir-1 as possible and build on top of it the additional capabilities required in the TRMM Release (See Appendix A). The TRMM Release A Search & Order tool is developed to V0 standards by the VO TEAM and the rest of the Client Subsystem is developed by the ECS team. The software development methodology for the TRMM Release is both incremental development track and the formal development track.

Software developed to provide capabilities which are part of the Communication Subsystem (CSS), Client Subsystem Interoperability Subsystem, and Data Management Subsystem in the TRMM Release is developed under the incremental development track. Software developed for all other subsystems is based on the formal development track. It is important to note that the incremental and formal development track are two methods of developing software that differ in the timing of the documentation, review, and the requirements being met. The underlying functionality of the software is irrespective of the method used to develop it.

The distinction between the software developed on the incremental track and on the formal track will cease when the system level test for TRMM Release commences. The TRMM Release software fielded at the DAACs will be a single integrated package of software which meets all functional and performance release requirements, regardless of the methodology used to develop it.

7.2 Transition of Ir-1 Based SSI&T to TRMM Release

The Ir-1 based SSI&T environment will be replaced by the TRMM Release. This replacement may include change out of tools as a result of their evaluation in the Ir-1 environment. The functionality provided by software in Ir-1 to support SSI&T will be wholely incorporated in the TRMM Release design and subsequently in the implemented software. When the TRMM Release is operational at its specified DAACs, it will provide the comprehensive SSI&T environment capabilities in Ir-1 plus additional tools and scripts developed to support SSI&T of SDP software. DAAC-specific policies will regulate availability of any tools that were part of Ir-1 but that have been changed out in the TRMM release.

7.3 Ir-1 Software Enhancement and Bug Fixes

The delivery and fielding of Ir-1 software does not conclude the Ir-1 activities. The software and system problems identified during various testing phases (System I&T, Independent Acceptance Test, independent verification and validation (IV&V)) will be prioritized for resolution. The high priority problems (anticipated to be small in number) will be resolved, tested, and delivered prior to TRMM Release in accordance with appropriate and extant CCB authorizations (ECS, ESDIS, and DAAC). The details of how this gets accomplished is largely a policy issue and outside the scope of this paper.

A small team of Ir-1 developers and testers will accomplish the task of maintenance support for the Ir-1 software in parallel with the TRMM Release implementation through its completion. All other outstanding software and system problems will be incorporated into TRMM Release problem list. The resolution of such residual problems outstanding from Ir-1 in the TRMM Release will be dictated by the priority, resources, and schedule availability.

7.4 TRMM Release Hardware Delivery to DAACs

TRMM Release hardware is scheduled first for delivery to the ECS Development Facility (EDF), and subsequently to the GSFC, LaRC, MSFC, and to the EDC DAACs. NASA's consent for the procurement of the hardware and Commercial Off The Shelf (COTS) S/W for the EDF is anticipated by July 1995. The subsequent delivery and installation of the hardware and COTS at the EDF will take place during the August to October 1995 period.

NASA's consent for the procurement of the TRMM Release hardware and COTS for the four DAACs is anticipated by March 1996. The delivery and installation of the hardware and COTS at the DAACs will take place over the period from March through mid-August 1996.

The phased DAAC hardware delivery agreed upon by NASA GSFC is as follows:

PHASE	Processing Capacity Phasing Parameter
TRMM Launch	.3x
TRMM Launch	1.2x
TRMM Launch + 1 year	2.2x
TRMM Launch + 2 years	4.2x

The TRMM Launch - 1 year hardware allocation was based on the Ir-1 support for SSI&T of TRMM and AM-1. All allocations are based on the requirements to support normal processing, reprocessing, and SSI&T.

ECS's nominal requirements for enlarging (to include MSFC) the EBnet circuit which supports the V0 client will be provided to EBnet management in advance of the deployment of the TRMM Release hardware at the DAAC.

7.5 TRMM Release Post-RRR Testing and Transition to Operations

After the TRMM Release has been deployed at the EDF and the DAACs and the Release Readiness Review (RRR) has concluded, the TRMM Mission Release Testing by the IV&V organization takes place followed by site-specific testing by the DAACs. Among the numerous site and system tests are TRMM Release-specific tests, ECS TRMM Release component test, revalidation of the TRMM interfaces, and validation of the TRMM external science data processing segment (SDPS) interface. TRMM System Certification Testing is performed at the beginning of the TRMM operations readiness preparations. While the TRMM System Certification Testing continues until the TRMM System Freeze, the TRMM Release M&O support is scheduled to start at the end of January 1997. TRMM M&O launch readiness support begins April 1997. At this time, console operations training starts in parallel with the continued certification testing and mission readiness preparations. TRMM Release operations at that time includes V0 migration/interoperability, TRMM SSI&T, TRMM System Certification Testing, and AM-1 SSI&T.

Ir-1 site M&O (supported by ECS) in progress as of Fall 1996 continues only until Ir-1 is decommissioned. Details of the transition by which the TRMM Release operational system subsumes Ir-1's support of SSI&T are in the process of being identified at the time of this publication.

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8. Transition from TRMM Release to EOS AM-1/Landsat 7 Release

This section describes briefly the design philosophy of TRMM Release with respect to EOS AM-1/Landsat 7 Release; support of operations for TRMM Release concurrent with Testing for EOS AM-1/Landsat 7 Release; and transition to EOS AM-1/Landsat 7 Release operations.

8.1 TRMM Release Development Approach

The TRMM Release strategies to minimize the breakage of software from TRMM Release to EOS AM-1/Landsat 7 Release include the following:

- scale software to EOS AM-1/Landsat 7 Release demands
- eliminate technology insertion/changes in the EOS AM-1/Landsat 7 Release unless there are overriding technical reasons that dictate it
- ensure that the criteria for COTS selection for TRMM Release includes the scalability considerations
- for the technology selection in various areas take into account EOS AM-1/Landsat 7 Release requirements to avoid insertion of new technology between TRMM Release and EOS AM-1/Landsat 7 Release

The schedule constraints of TRMM Release will, however, limit the leeway TRMM Release development team has in this regard (e.g., product availability constraints).

8.2 Concurrent Support of TRMM Release Operations and EOS AM-1/Landsat 7 Release Testing

Starting after the Consent To Ship (CSR) review for the EOS AM-1/Landsat 7 Release, the DAACs will support TRMM Release operations and EOS AM-1/Landsat 7 Release testing. The overall system design and configuration must support concurrent testing of EOS AM-1/Landsat 7 Release software with TRMM Release operations.

The requirements for a stand-alone hardware string/resources for test and integration assure that test needs do not interfere with the ongoing operations. In addition, TRMM Release design must have features that support concurrent operations and testing. Closer examination of this issue indicates that this is more a procedural and operational challenge for DAACs, M&O, and EOS AM-1/Landsat 7 Release development than a design challenge for TRMM Release. For example, Planning and Data Processing System (PDPS) design has the capability to identify planning data base records created by operations and those created by testing, should DAACs choose to use the same instance of planning data base for TRMM Release operations and EOS AM-1/Landsat 7 Release test/integration. The DAAC operations staff will not want to clutter up their operational planning data base with test records that need to be deleted/ignored from time to

time. Data Base Administration (DBA) scripts developed to take care of this aspect increase the possibility of error. Also, system start-up, shutdowns performed in testing and system crashes occurring in testing could adversely affect the operations with this approach. This discussion indicates a need to develop a detailed operations concept to solicit DAAC inputs and drive EOS AM-1/Landsat 7 Release operational procedures.

8.3 TRMM Release Software Enhancement and Bug Fixes

After the Release Readiness Review (RRR), the TRMM Release development activities end including pre-RRR maintenance provided under the purview of the Science and Communications Development Office (SCDO). The Maintenance and Operations organization takes over the software and system problems identified during various testing phases (pre-RRR System I&T at EDF, Independent Acceptance Test, IV&V). A small team of TRMM Release developers and testers will provide consulting support to the Maintenance and Operations organization, as needed, to facilitate problem resolution and bug fixes. The details are provided in DID 601, the Maintenance and Operations Management Plan.

9. TRMM Release Implementation Strategy

9.1 TRMM Release Implementation Planning Objectives

In addition to the overall objectives of maintaining a smooth staffing profile as much as possible and balancing the workload in terms of the total size of custom code development and COTS integration, the philosophy employed in planning the TRMM release implementation is based on the following considerations:

- the need to define cohesive increments for integration testing
- early implementation of intra- and inter-subsystem dependencies
- early implementation of complex functions/interactions to provide enough time to test and fix problems so as to ensure a stable and robust core system
- early implementation of the custom GUIs to facilitate early user/operator familiarity,

The implementation strategy takes the CSR date of October 1, 1996, includes a minimum float of 30 calendar days, and works backwards to implement the TRMM Release. The goal is to provide as much time as possible to coding and unit testing without compromising the time available for subsequent testing. Excepting the initial months of the implementation phase when the integration test group will be finalizing the test cases and procedures, the coding and unit testing is planned to take place in parallel with the integration test activities.

9.2 TRMM Release Implementation Phases and Schedules

The implementation is divided into three overlapping phases, each of which has two distinct functional parts: code through unit test and integration/system test. The integration/system test activity for the TRMM release is a continuous activity, increasing in complexity and magnitude as more software is integrated. The completion of code and unit test for each discrete increment of software (one increment per phase) will mark the beginning of the establishment of a new test baseline. Integration/system test of the successive increments of software continues until the release of the software one month prior to the TRMM Release CSR.

The first of the phases within implementation starts on August 20, 1995 following the CDR and is targeted to conclude around March 1, 1996 (See attached schedule: TRMM Release Schedule - Key Events). The coding and unit test is expected to finish around December 1, 1995. The integration test for the first phase will start subsequently.

The second phase is expected to start around December 1, 1995 with code and unit test. The coding and unit testing for the second phase will conclude around March 1, 1996. The integration of the second phase software will start on March 1, 1996.

The third phase will start around March 1, 1996 with code and unit test. The coding and unit testing for the third phase is expected to conclude around June 1, 1996. The integration of the third phase software will start on June 1, 1996.

The integration test of all TRMM Release software will conclude by September 1, 1996 at the time of the TRMM Release CSR. This proposed schedule leaves 30 days of float from the contractual CSR date of October 1, 1996 for the TRMM Release.

The TRMM Release Schedule (Figure 9.2-1) shows the parallel conduct of integration test for earlier phases of implementation with coding and unit test for later phases. The schedule dates specified above are the proposed dates for the interim milestones/phases of the TRMM Release implementation. This internal schedule represents a plan, and may be modified to ensure cohesion per phase across all subsystems in functional capabilities to be tested, or because of the size and number of build/test threads for each phase. The planning to allocate functionality to each phase of implementation will be finalized by CDR.

9.3 TRMM Release Deployment

The TRMM Release Deployment & Operations Schedule is attached, showing the post-RRR schedule for deployment of the TRMM Release at the DAACs for Acceptance Testing (AT), and Independent Verification and Validation (IV&V), and additional DAAC Testing. The schedule for M&O support for TRMM Release is also shown. In addition to GSFC, M&O support is provided at both the LaRC and MSFC DAACs.

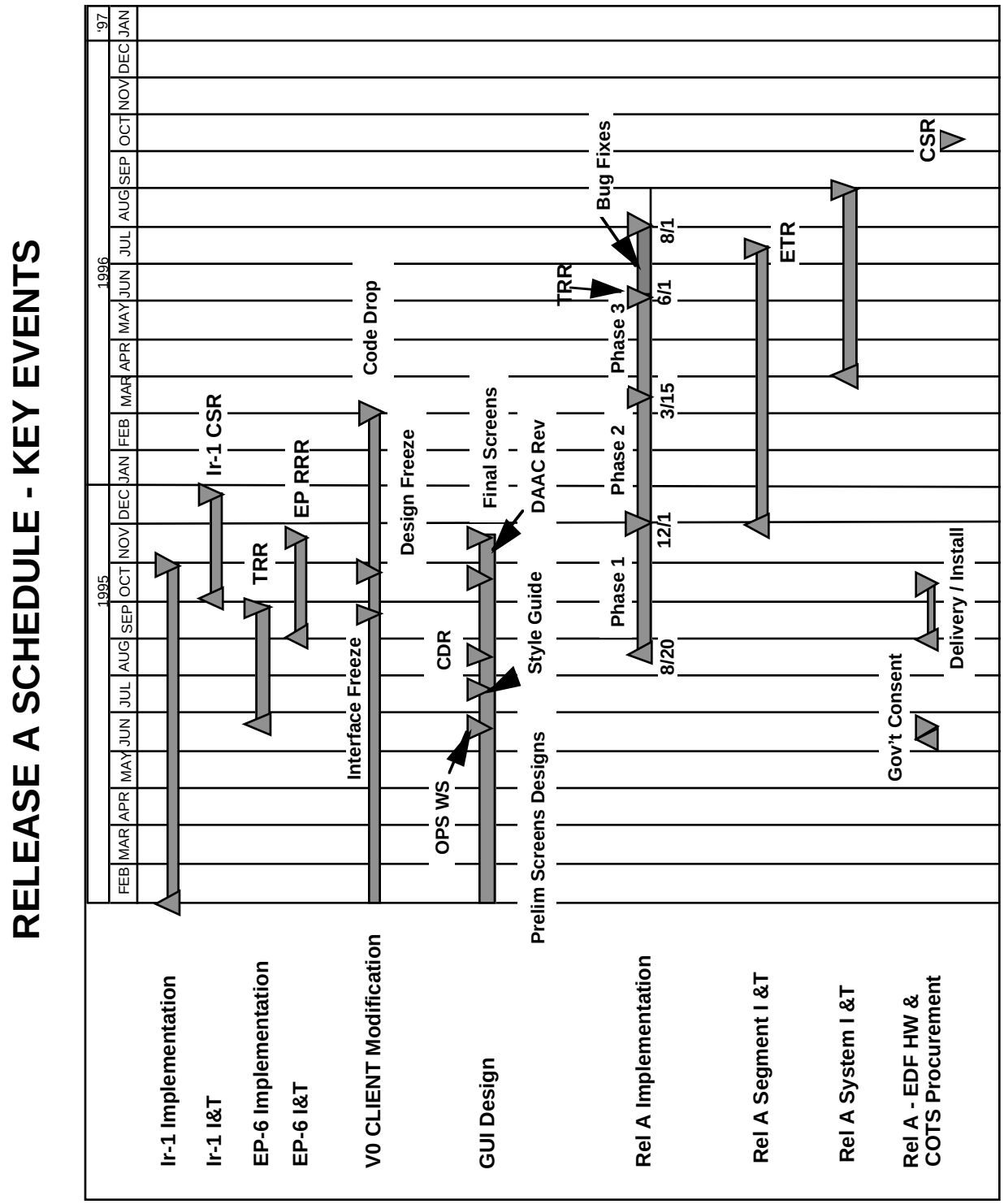

Figure 9.2-1. Release A Schedule (1 of 2)

RELEASE A SCHEDULE - KEY EVENTS

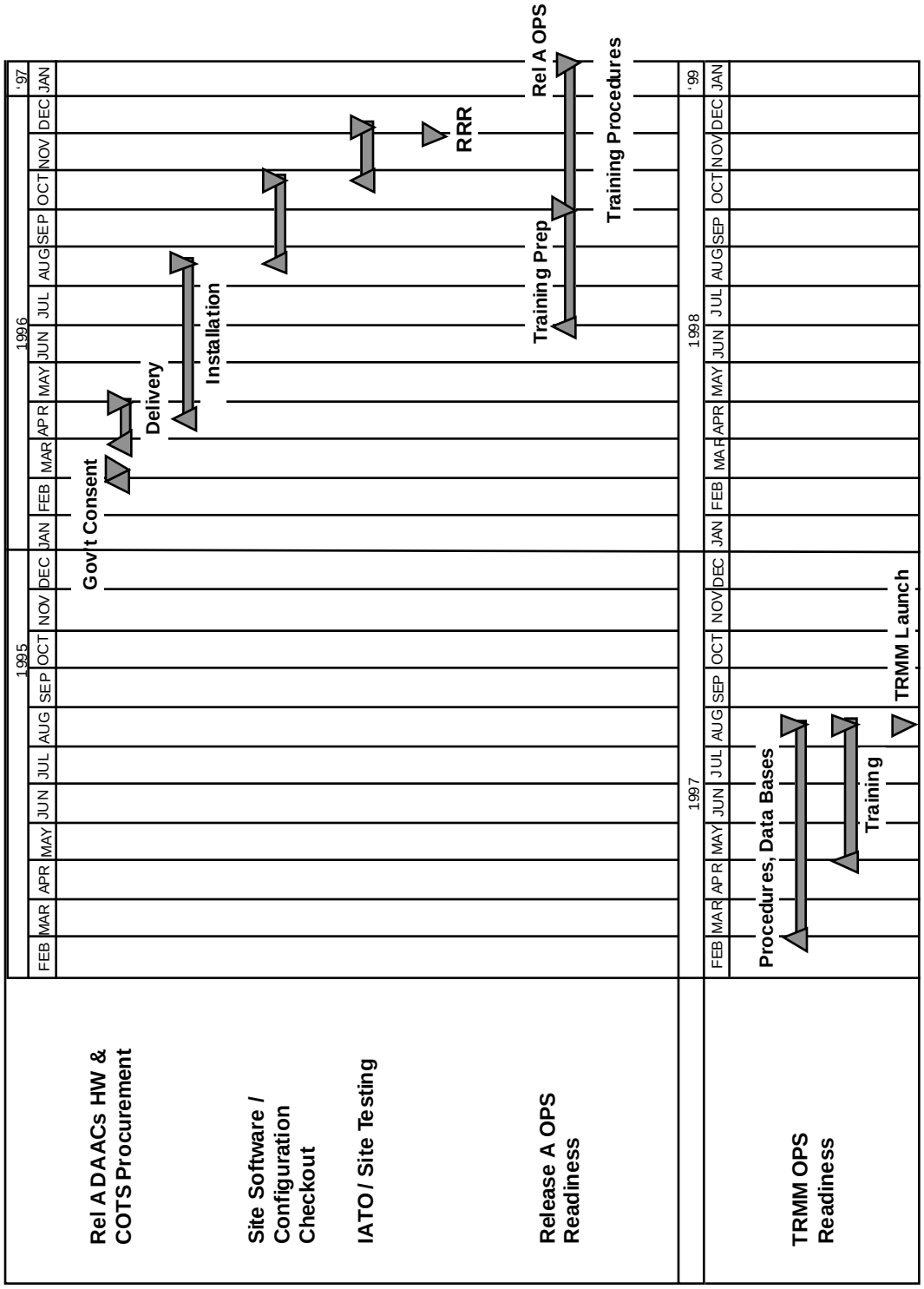

Figure 9.2-1. Release A Schedule (2 of 2)

Appendix A. TRMM Release Capabilities

The TRMM Release capabilities consist primarily of two parts: 1) TRMM Release capabilities, the main functionality developed specifically to support TRMM and the EOS AM-1/Landsat 7 interface testing, and 2) the Ir-1 capabilities that the TRMM Release is built on. The Ir-1 capabilities are described in separate documents. The reader is referred to the Mission Statement for Ir-1 White Paper for the ECS Project, Document No. 222-WP-001-001 for a comparably high-level description of the functionality and environment provided by Ir-1.

The following paragraphs describe the capabilities currently planned by each development group. The description is consistent with the current Release Plan submitted to the SMO office.

A.1 Client Subsystem

The TRMM Release Client Subsystem provides the GUI interfaces to access ECS services. The Client subsystem will provide two major components; the Desktop Computer Software Configuration Item (CSCI) and the Workbench CSCI.

For TRMM Release, the Workbench CSCI search and order functionality will be provided by the V0 Client application. In order to reuse the V0 Client, the TRMM Release Client Subsystem will support modifications to the V0 Client, integration and testing of the Client as well as delivery with the TRMM Release ECS system. The reader is referred to the document "Implementation Plan for V0/ECS Integration" for more detailed information about the integration of the V0 client. The Workbench CSCI will also provide a world-wide-web browser that will be used to access BCS services via hypertext links. BCS services that can be accessed from the web browser include advertising, document data server, user registration, user profile, and on-line help.

The Client Subsystem also provides a Desktop environment, which provides a general framework for organizing and presenting the various application objects (both data and programs) with which a user interacts with the ECS system and services. There are two basic kinds of desktop objects:

- Tools: Opening a tool object launches the corresponding program according to a default script
- Data Objects: Opening a data object launches an application associated with that data object's type

The environment includes a Desktop Manager, which provides a single GUI interface that manages desktop objects in the user's local file space,

All of the ECS TRMM Release GUI applications, including administrative utilities, will be delivered as Desktop Tool Objects. The TRMM Release Client will also be delivered as a standard Desktop object.

A.2 Interoperability Subsystem (IOS)

The TRMM Release Interoperability Subsystem provides the capability to support interactive browsing, searching, and submission of advertisements. In addition, a user can subscribe to the moderated advertising service to be notified of changes, deletions, or new submissions of advertisements. There will be a single format for submitting advertisements to the service, however, advertisements should be accessible via several different interfaces to support database searching, text searching, and hyperlinked access and retrieval. Read and write access controls will be maintained for all advertisements based upon a to-be-specified ECS user class as well as membership in an advertising group. Advertisements can be accessed and submitted through a world-wide-web interface or via OODCE API.

A GUI application, the Advertising Client, is also provided for accessing the advertising service. The Client will support searching, browsing, and submission of advertisements. The Client will also support the installation of services which are advertised.

A.3 Data Management Subsystem (DMS)

The TRMM Release Data Management subsystem provides the interface between the V0 Client and the ECS Data Servers. Since the V0 Client is to be reused (with enhancements) as the ECS TRMM Release Client, the TRMM Release components are focused on providing an interface between the V0 Client and the ECS Data Servers. There are two Data Management components to be developed for TRMM Release to accomplish this interface:

- The Data Dictionary Service (DDS) will provide a translation from the ECS Data Server terms and definitions to the V0 list of permitted values (i.e. Valids). The ECS Data Servers will be able to automatically export their data dictionary updates to the DDS as part of the ECS schema management process. The DDS will map the terms into V0 permitted values and export them in a format suitable for ingestion by the V0 update process. The DDS will also be used by the V0 Gateway for bi-directional mapping of ECS and V0 data structures, terms and definitions.
- The V0 Gateway will provide translation between V0 protocol and the ECS Data Server protocols. The Gateway will translate an incoming request from V0 Object Description Language (ODL) into the ECS query language and submit it to the local ECS Data Server. The result will be returned to the Gateway, which then will reformat it into V0 ODL structures and return it to TRMM Release client. This will allow request to be placed via the TRMM Release client to be handled by the ECS Data Servers in a transparent fashion.

A.4 Communication Subsystem (CSS)

Characterized as "middleware", the Communication Subsystem (CSS) is a broad collection of services providing flexible interoperability and information transfer among EOSDIS Core Systems (ECS) clients and servers as well as those outside ECS. The CSS includes three loosely related collections of services:

- Common Facilities

- Object Services
- Distributed Object Framework

The Common Facilities include legacy communications services required within the ECS infrastructure for file access and transfer, electronic mail, bulletin board, and remote terminal support. The Object Services support all ECS applications with interprocess communication and specialized infrastructure services such as security, directory, and event handling. The Distributed Object Framework provides services required to support both the development and execution of object-oriented, client-server application services.

The services of the Communications Subsystem are functionally dependent on the services of the Inter networking Subsystem. The services of the common facility, object and data operations facility (DOF) are the fundamental set of interfaces for all communications and systems management segment CSMS management and flight operations segment (FOS) and SDPS user access (i.e., pull) domain services. The DOF services are the fundamental set of dependencies of the common facility and object services.

A.4.1 Description of Services:

The following paragraphs describe the various services provided by the CSS Subsystem

A.4.1.1 Bulletin Board (BB)

The Bulletin Board Service provides a forum for sharing ECS related information. It consists of multiple moderated bulletin boards organized according to subjects.

M&O staff and applications post information that relates to ECS services, products, status, events and news for the ECS users. Users (both registered and non registered) may report problems, suggest enhancements, ask questions, get information and collaborate with the other users.

The service consists of interactive portion that allows users to browse and post messages to the bulletin boards, download ECS Toolkits and register with ECS. To the applications, it provides an application program interface (API) that enables them to post messages to the bulletin board(s).

A.4.1.2 Electronic Mail Service w/MIME

The Electronic Mail Service provides the capability to manage electronic mail messages to its operators and applications. A MAILBOX (mail account) exists only for each member of the FOS operations and M&O staff at the DAAC. ECS does not provide mail accounts to its end users.

All incoming mail is stored in the MAILBOX of the respective MailUser. The interactive portion of the service consists of a mail tool that allows a MailUser to view and store the incoming mail, compose and send new messages, respond or forward received messages, browse the message archives, etc. MailUsers utilize the service to communicate with other users (both within and outside the ECS domain).

The Electronic Mail Service supports the Simple Mail Transfer Protocol (SMTP) and uses the existing X.400/SMTP gateway at GSFC.

A.4.1.3 File Access Service

The File Access Service provides file transfer via file transfer protocol (ftp) and management capabilities. It consists of an interactive tool that allows file transfers to the operators, a programming interface (API) for applications to transfer files. Secure file transfers are supported through Kerberos FTP

A.4.1.4 Distributed Object Framework

Object Oriented applications consist of a number of interrelated objects. Each object is characterized by a set of attributes and methods. Each object has a clear interface that identifies the methods a user can invoke and get responses to.

The object that requests information is called the requester and the object that provides a service is called the provider. Each provider object takes requests for operations that it has identified in the interface, performs the service, and passes the results back to the requester. Object-oriented application development consists of defining and instantiating the objects and passing messages (invoking methods) between the objects to achieve its objective.

Distributed Object Framework an infrastructure to develop client server applications in an object oriented environment

A.4.1.5 Directory/Naming Service

Directory Naming is one of the fundamental facilities needed in distributed environments to uniquely associate a name with resources/principals along with some information so they can be identified and located by the name even if the named resource changes its physical address over time.

Naming is used primarily by service providers to register information about a service and by clients to locate the services. Naming may be used more generally to store and retrieve any general information that is required to be made available about a resource across a network.

CSS will provide an implementation of both the DNS and the X.500 namespaces and the federated naming service interface through which application programmers can store and retrieve information in the locally supported namespace.

A.4.1.6 Event Logger Service

The Event Logger Service provides an application interface (API) which enables recording application defined events and associated information to a log file. Applications can use the service for debugging and tracing . The MSS Services will also use the service to record fault, security and performance events in the system. Management data collected in the log files by the MSS services will be accessed by the MSS Common Data Access Service and will later be used

for generating reports, tracking resource usage, collecting performance data, doing timing and statistical analysis.

The data is first recorded into a flat file and later transferred to a relational database which makes it easier to query and generate reports on the data. Depending on the severity of the vents, it also sends notifications to the management applications (HP Openview)

A.4.1.7 Life Cycle Service

The purpose of the LifeCycle Service is to provide the functionality to start up, shut down, suspend and resume server applications. In addition LifeCycle service supports functionality to create and destroy objects in different address spaces through object factories.

A.4.1.8 Message Passing

ECS distributed computing consists of several clients and server applications running on different platforms. Clients send data to servers, which process the data and return the result to the client. This interaction, message passing, can be classified into three categories: synchronous, asynchronous and deferred synchronous. All three forms of message passing are supported in the TRMM Release.

In synchronous mode, the client waits for a reply/request from the server, in asynchronous mode the client continues immediately, that is, it makes a non blocking request, and in deferred synchronous mode, the client makes a call and gets a ticket back from the server. Both, the server and the client can continue with the processing simultaneously and the client can at a later time get the result of the request.

A.4.1.9 Security Service

In distributed systems, applications rely on services provided by servers running in different address spaces and on heterogeneous platforms. Servers are independent and their main functionality is to listen for client requests, process the request and send the results back to the clients. In addition to a client invoking a request, and the server processing that request, both the client and the server may need to use mechanisms to protect resources as well as the integrity of the data exchanged.

These mechanisms comprise authentication, authorization, data integrity and data privacy. While authentication is always used in every conversation between a client and a server, the mechanisms for authorization, data integrity and privacy may be used based on the need for those mechanisms.

Authentication is the process of verifying the validity of a principal. Authorization is the process of deciding what sort of users/groups should be allowed to access what services/resources and then allow/deny the service. Data integrity is needed to make sure that the copy of the data the receiver gets is exactly the same as the data that the sender sends. Encryption is the process of encoding a message into cipher text using a key to prevent intruders reading the contents of the message.

A.5 Management Subsystem (MSS)

For TRMM Release, MSS will provide local (at each TRMM Release site) monitoring, fault management, performance management, ECS resource management, site software, hardware and document CM, physical Configuration Management, suite of Office Automation (OA) tools to augment TRMM Release delivered services, a Data Base Management Package to support data collection and ad-hoc reporting, ground event scheduling, and a trouble ticketing package to help maintain and resolve problem reports. A Management User Interface (MUI) is provided by a management framework product through which the management applications will be provided. A brief summary of the capabilities provided for TRMM Release follows.

A.5.1 Fault Management

The LSM will provide real-time monitoring, detection, isolation, diagnosis and recovery from network, hardware, and limited software faults occurring within the site domain. Provided mostly through COTS packages with some customization of agent, MIB, and configuration of Openview and Tivoli.

A.5.2 Performance Management

The LSM will provide real-time performance monitoring and reporting through HP Openview, post analysis and reporting through the database management system. SMC will receive summary reports and provide system wide performance analysis.

A.5.3 Configuration Management

Software, hardware and document configuration management will be provided by COTS package configured for each site. Individual sites will maintain information regarding their own sites, SMC will maintain system wide and baseline configuration. Site changes to the baseline will be coordinated with the SMC and updates distributed back the SMC baseline.

A.5.4 Security Management

MSS will provide limited security services in TRMM Release to support intrusion detection, file access attempts, log on authentication and authorization, and virus detection. SMC capabilities will be primarily to evaluate site reports and detect system-wide trends or related intrusion incidents.

A.5.5 Ground Scheduling

MSS provides site- and SMC-level Ground Resource Scheduling capabilities to support such things as maintenance, special events, software upgrades, and repairs. There are no cross-site dependencies among the TRMM Release data products. At the TRMM Release no automated cross-site schedule coordination or adjudication is planned or supported.

A.5.6 Trouble Ticketing

A COTS package to support generation, collection, tracking, and resolution of reported and detected problems, whether software or hardware or operational.

A.5.7 Report Generation

A relational DBMS will be provided for TRMM Release, to include a report writer, to maintain selected and summarized management data. The DBMS is encapsulated within the MSS software; thus external subsystems will be prohibited from direct queries of it.

Other functions such as Logistics, Training, Directory Information Services (other than user directory information), Inventory, Policies and Procedures, and Maintenance are being provided through office automation tools.

A.6 Planning and Data Processing Subsystem (PDPS)

Planning SWCI software generates a candidate plan based on the planning database information including simple production strategies/rules specified by the DAAC. The rules could be XYZ % of a shift/day for standard production, reprocessing, etc. or highest priority for standard production, lowest priority for reprocessing. The candidate plan is generated by the planning subsystem software based on an operator command/input via GUI. Planning SWCI provides GUI to the DAAC and Remote users to view the candidate plan. DAAC operators can generate and store multiple candidate plans, review them, and activate a candidate plan. Planning SWCI receives status messages from the processing SWCI and updates the status of the active plan on an ongoing basis. It also sends messages to the remote users if a delay is expected in meeting their production request.

Processing SWCI will receive data processing requests from planning SWCI based on the active plan. Processing SWCI will get the required data staged by the data server, queue the processing requests on available resources as specified in the data processing requests received from planning SWCI, monitors execution, sends appropriate status and error messages to the DAAC operators and Planning SWCI. Processing SWCI provides a GUI to the DAAC operators to view the status, receive the status and error messages, allow them to modify the priorities of processing requests, and requeue processing requests as needed on other available CPUs. Planning and processing subsystems support only standard production requests in TRMM Release. There is no support for on-demand processing in TRMM Release. The reprocessing support in TRMM Release is limited in that there is no flow control of reprocessing in TRMM Release to assure that a large reprocessing request consisting of several days will be completed by a certain date.

The algorithm integration test SWCI provides additional capabilities and tools to facilitate the integration process. It will build on the capabilities, scripts, and tools provided in Ir-1.

The data preprocessing SWCI provides functions/subroutines to reformat the header of level 0 data and preprocess orbit and attitude data as needed to get it ready in the binary format of the CPU that uses the data.

A.7 Ingest Subsystem

The TSDIS, Sensor Data Processing Facility (SDPF), DAO, and NESDIS interfaces are to be fully integrated to support TRMM launch in early 1997. Therefore, major elements of each Ingest subsystem component are required for TRMM Release. The EDOS, Landsat-7, AM-1/EOC, SeaWinds, RADAR ALT, ERS, and JERS missions require early interface testing in early 1997. Software developed to support TRMM interfaces is reused for the early interface testing.

The Network Ingest Interface, Request Manager, and Data Transfer Task Computer Software Components (CSCs) are to be fully developed for TRMM Release. The history log monitoring, request cancellation, and operator ingest request status capabilities of the Ingest Operator Interface CSC are fully implemented. The conversions, reformatting, metadata extraction, and metadata checking required for TRMM Release data sets are implemented as part of the Data Preprocessing Task CSC.

A.8 Data Server Archive and Distribution Subsystem

At TRMM Release the "core" of the Data Server will be delivered, along with services to the TRMM Release datasets. The approach is to provide core functions at TRMM Release and augment them over the following releases, both in terms of scope (i.e., more data types supported) and depth (i.e., more services available on these data types). A high-level list of the major Data Server functions includes those described below.

- **Reliable Archiving of Data**

  The Data Server will be configured to accept, process, and reliably store all TRMM Release and data identified as migrated V0 data. Data storage is accomplished by externally presenting a seamless integration of record and file-based storage technologies within the subsystem. Robotics linear tape technology (AML or STK robotics integrated with 3590), configured with a COTS FSMS (AMASS), coupled with a COTS data base engine (Sybase/SQS) will be fielded as the primary data storage mechanisms for this release. The Data Server is designed to support a site configurable, policy-driven backup strategy for data. It is the recommendation at this time that V0 data not be backed up in the TRMM release time frame (the V0 data source will be the backup for acquisition of this data). It is recommended that all TRMM products be backed up.

  All data that is eventually stored within the Data Server will, at some point during the insert process, be resident on an internal Data Server magnetic disk. Data received during the TRMM operations with be placed on this disk via an electronic file transfer or by reading from a piece of hard media. A specialized ingest client will be utilized to read data from hard media and place it on the Data Server's internal disks.

- **Reliable Retrieval of Data**

  All data that is retrieved from a Data Server's storage mechanisms will initially be placed on a Data Server's internal magnetic disk. From that point on, data routing and

processing is dictated by the nature of the data distribution request. Electronic distribution in the TRMM release will support file transfers in both "push" and "pull" modes. Electronic "push" is where the Data Server itself, based on information contained in the distribution request, places data on a destination storage resource of the requester's choosing. This is done a synchronously from the requester's point of view. Electronic "pull" is where the Data Server will supply information in a data availability notification to the requester. This notification will alert the requester to the availability of the data and supply the information necessary for the requester to initiate a file transfer procedure. Data identified as pull data will be retained in the manner identified in the data availability notification for a finite (tunable) period of time.

Data can also be distributed in the TRMM release via hard media. 8 mm and 6250 bpi tape form factors will be supported, as well as CDs. Tar and cpio logical formats will be supported on the tapes.

- **Browse Data**

  Browse data will also be supported in those cases where browse has been identified and is applicable. Browse data will be stored in the persistence storage technology associated with the browse data's data type. For example, browse data that is file-based will be stored in file storage technologies. Browse data that is record-based will be stored in DBMS technology. Browse data is "distributed" directly to the requesting client electronically when requested via a browse request. World-Wide-Web browsing is supported.

- **Archive Management**

  To support the control and operation of the system, functional management of the file-based archives will be provided in the TRMM release. The goal is to provide the functions necessary for reliable storage, maintenance, and retrieval of data. These functions include control over the mounting and dismounting of media, backup and restore operations, status monitoring of all storage and robotics devices, and control and management of the staging disk areas. More sophisticated capabilities such as scanning of data holdings, BER monitoring, automated media refresh, etc., are scheduled for later releases.

- **DBMS Management**

  DBMS management will be supported mostly through the COTS DBA interface. DBMS backup and restore operations as well as transaction monitoring and management will be included.

- **Request Processing**

  Requests for TRMM release-supported Data Server services will be monitorable by the operations staff as the requests are processed by the system. The operations staff will be capable of viewing all Data Server requests, active and pending. A requester will be permitted to list and status the requests submitted by that requester only. The operations staff will have the capability to delete or terminate all requests within the Data Server. Requesters will have the capability to delete or terminate requests submitted by the

requester. Requests priorities will be supported in the TRMM release, with operations staff having the capability to alter the priorities of the requests.

- **Logging of activities**

  All critical request processing and data handling flows will be logged via MSS logging utilities. MSS utilities will also be utilized to view logs.

- **Subscriptions**

  Subscriptions have two primary parts: 1) events that trigger the subscription; and 2) actions that are performed as a result. In the TRMM release the following will be supported:

  – Events

    Receipt of Data - A data type being inserted is a subscribable event

    Core Metadata Change - A data type's core metadata changing (e.g., Q/A flags) is a subscribable event

  – Actions

    Distribute Data - Push scenario

    Send Notification - Pull scenario

- **Resource Control**

  The Data Server will support (and requires operationally) the ability to allocate resources for a particular request or process. These resources are mostly the I/O devices used by the Data Server for Insert and Distribution functions.

  A unique and critical Data Server resource that requires management is the staging disk space. Operations staff will be able to view usage, view and change space thresholds (to be used for request throttling), and manage the allocation and reallocation of the space to requests.

- **Hyper Text and ASCII Documents**

  Hyper Text Mark-up Language (HTML) and ASCII documents will be supported in the Document Data Server in the TRMM Release. Access to documents will include World-Wide-Web style browsing and searching.

Abbreviations and Acronyms

ABL	allocated baseline
ACI	allocated configuration identification
ACMHW	Access Control and Management Hardware
ADADS	ASTER Data Archive and Distribution System
ADC	affiliated data center
ADEOS	Advanced Earth Observing Satellite (Japan)
AERO	see EOS-AERO
ADN	ASTER Data Network
ADPE	automated data processing equipment
ADS	archive data set
AFGWC	Air Force Global Weather Central
AFSCN	Air Force Satellite Control Network
AGDS	ASTER Ground Data System
AGS	ASTER Ground System
AGU	American Geophysical Union
AHWGP	Ad Hoc Working Group
AI&T	Algorithm Integration and Test
AIF	Algorithm Integration Facility
AIT	algorithm integration and test
AITHW	Algorithm Integration and Test Hardware
AM	morning (ante meridiem)
AM-1	EOS AM Project spacecraft 1, morning spacecraft series -- ASTER, CERES, MISR, MODIS and MOPITT instruments
ANSI	American National Standards Institute
Ao	operational availability
AOIPS	Atmospheric and Oceanographic Information Processing System
AOS	ASTER Operations Segment
APC	access/process coordinators
API	application program (or programming) interface

APID	application’s identifier
AQAHW	Algorithm QA Hardware
ARAM	automated reliability/availability/maintainability
ARC	Ames Research Center
ARC	Antarctic Research Center
ARGOS	Argos Data Collection And Position Location System
ARIN	Aerospace Resource Information Network
ARISTOTELES	Applications and Research Involving Space Technologies Observing the Earths' Field from Low Earth Orbiting Satellite
ASCII	American Standard Code for Information Exchange
ASF	Alaska SAR Facility (DAAC)
ASI	Agenzia Spaxiale Italiano
AST	algorithm support team
AST	ASTER Science Team
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer (formerly ITIR)
AT	acceptance test
ATBD	algorithm theoretical basis document
ATLAS	Atmospheric Laboratory for Applications and Science
ATRR	Acceptance Test Readiness Review
ATT	acceptance test team
AVHRR	Advanced Very High-Resolution Radiometer
BB	bulletin board
BNSC	British National Space Centre
bpi	bits per inch
Bps/bps	bytes per second
C&DH	command and data handling
C&DHS	Command and Data Handling Subsystem (AM-1)
C&DM	configuration and data management
C&T	communications and tracking
CCB	Change Control Board (Hughes Convention)
CCB	Configuration Control Board (NASA Convention)

CCR	configuration change request
CCRS	Canada Centre for Remote Sensing
CCS	Common Carrier Subsystem (Ecom)
CCS	Communications and Control Segment (NCC)
CCSDS	Consultative Committee for Space Data Systems
CDDIS	Crystal Dynamics Data Information System
CDIAC	Carbon Dioxide Information and Analysis Center (also DOE/CDIAC)
CDIC	Carbon Dioxide Information Center
CDR	Critical Design Review
CDRC	CIESIN Data and Research Center
CEC	Commission of European Committees
CEO	Centre for Earth Observation (ESA)
CERES	Clouds and Earth's Radiant Energy System
CEES	Committee on Earth and Environmental Sciences
CESDIS	Center for Excellence in Space Data and Information Sciences
CESDS	Central Environmental Satellite Data System (NOAA)
CF	customer facility
CHEM	see EOS-CHEM
CI	configuration item
CIDM	Client, Interoperability, Data Management Subsystem
CIESIN	Consortium for International Earth Science Information Network
CIL	common interface language
CM	configuration management
CMD	command
CMS	Command Management System (for UARS)
CNE	Campus Network (GSFC)
COMMS	Communication Subsystem (AM-1)
CORBA	common object request broker architecture
COSMIC	Computer Software Management and Information Center (NASA)
COTS	commercial off-the-shelf (hardware or software)
CPL	computer program library

CPU	central processing unit
CR	change request
CRISTA	Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere
CRL	Communication Research Lab (Japan)
CSA	Canada Space Agency
CSAT	Center for Space and Advanced Technology -- see ESSi
CSC	computer software component
CSCI	computer software configuration item
CSDTs	computer science data types
CSMS	Communications and Systems Management Segment (ECS)
CSR	consent to ship review
CSS	Communication Subsystem
CTIU	Command and Telemetry Interface Unit (AM-1)
CTV	compatibility test van
CZCS	Coastal Zone Color Scanner
D/L	downlink
DAAC	Distributed Active Archive Center
DADS	Data Archive and Distribution System
DAMUS	Data Assimilation Office
DAR	data acquisition request
DAS	Direct Access System (AM-1)
DB	direct broadcast (AM-1)
DB	database
DBA	database administrator
DBMS	database management system
DCE	distributed computing environment (OSF)
DCF	data capture facility
DCR	data collection request
DCTT	DSN Compatibility Test Trailer
DDF	Data Distribution Facility (Pacor)
DDL	Direct Downlink (AM-1)

DDS	data dictionary service
DHF	data handling facility
DIB	directory information base
DID	data item description
DID	data ingest/distribution
DIF	Data Interface Facility (EDOS)
DIM	distributed information manager (SDPS)
DIPHW	Distribution and Ingest Peripheral Management Hardware
DIS	data information system; data interface system
DLPDU	data link protocol data unit
DLPO	DoD Landsat Program Office
DM	data management
DME	distributed management environment (OSF)
DMGHW	Data Management Hardware
DMO	data management office
DMR	Detailed Mission Requirements
DMS	Data Management Subsystem
DOC	distributed object computing
DOF	Data Operations Facility
DORRAN	Distributed Ordering, Reporting, Researching, and Accounting Network
DP	data processing
DP	direct playback (AM-1)
DPF	Data Production Facility (EDOS)
DPFT	Data Processing Focus Team
DR	discrepancy report
DRD	data requirements document
DRL	data requirements list
DRPHW	Data Repository Hardware
DRR	Data Readiness Review
DRS	direct downlink receiving station
DRTS	Data Relay and Tracking Satellite (Japan)

DSCC	Deep Space Communications Complex (DSN)
DSN	Deep Space Network
DTF	development and test facility
E-mail	electronic mail
EAS	Electrical Accommodation Subystem (AM-1)
EBnet	EOSDIS Backbone Network
Ecom	EOS Communications
ECS	EOSDIS Core System
EDC	EROS Data Center (DAAC)
EDF	ECS Development Facility
EDHS	ECS Data Handling System
EDMP	ECS Data Management Plan
EDOS	EOS Data and Operations System
EDS	Earth Data System (NIIT)
EECF	Earthnet ERS-1 Central Facility (ESA)
EGS	EOS Ground System
EMOC	EOSDIS Mission Operations Center
EOC	EOS Operations Center (ECS)
EODC	Earth Observation Data Centre (UK)
EOS-AERO	EOS Aerosol Mission (see SAGE III instrument)
EOS-ALT	EOS Altimeter Mission (see DORIS, TMR, SSA and GLAS instruments)
EOS-AM	EOS Morning Crossing (Descending) Mission -- see AM-1
EOS-CHEM	EOS Chemistry Mission (see SAGE III, MLS/SAFIRE, HIRDLS, SOLSTICE and ACRIM instruments)
EOS COLOR	EOS Ocean Color Project
EOS	Earth Observing System
EOS-PM	EOS Afternoon Crossing (Ascending) Mission (afternoon spacecraft series) (see AIRS, AMSU-A, MHS, MIMR, CERES and MODIS instruments)
EOSDIS	Earth Observing System Data and Information System
ERBE	Earth Radiation Budget Experiment
EROS	Earth Resources Observation System
ERSDAC	Earth Resources Satellite Data Analysis Center (Japan)

ESDIS	Earth Science Data and Information System (GSFC)
ESIC	Earth Science Information Center
ESID	EOSDIS systems interface document
ESMO	Earth Science Mission Operations
ESN	EOSDIS Science Network (ECS)
ESTOL	EOS Standard Text and Operation Language
ETS	EOSDIS Test System
F&PR	Functional and Performance Requirements
F&PRS	Functional and Performance Requirements Specification
F/L	forward link
FDD	Flight Dynamics Division (GSFC Code 550)
FDDI	fiber distributed data interface
FDF	flight dynamics facility
FEP	front end processor
FMEA	Failure Modes and Effects Analysis
FOC	final operational capability
FOS	Flight Operations Segment (ECS)
FOT	Flight Operations Team
FRR	flight readiness review
FS	flight segment
FTP	file transfer protocol
GB	gigabyte (10^9)
Gbps/GBps	gigabit/gigabyte per second
GByte	gigabyte (10^9)
GCDIS	lobal Change Data and Information System
GCMD	Global Change Master Directory
GCF	ground communications facility (DSN)
GDS	ground data system
GFLOPS	giga (billions of) floating-point operations (10^9) per second
GIF	Graphical Interchange Format
GIPS	giga (billions of) instructions (10^9) per second

GIS	Goddard Information System
GLIS	Global Land Information System (EDC)
GMT	Greenwich mean time
GN	ground network
GOS	Geomagnetic Observing System
GPCP	Global Precipitation Climatology Project
GPS	Global Positioning System
GGS	[EOS] ground system Ground Segment
GS&O	Ground Systems and Operations
GSFC	Goddard Space Flight Center
GUI	graphic user interface
H/K	housekeeping
H/W	hardware
HAC	Hughes Aircraft Corporation
HDF	hierarchical data format
HDLC	high level data link control
HITC	Hughes Information Technology Company
HP	Hewlett Packard
HTML	HyperText Markup Language
HWCI	hardware configuration item
I&AT	Integration and Acceptance Test
I&T	integration and test
I/F	interface
I/O	input/output
IATO	Independent Acceptance Test Organization
ICAI	interactive computer-aided instruction
ICC	Instrument Control Center (ECS) (ASTER)
ICD	interface control document
ICF	Instrument Control Facility (ECS)
ICLHW	ingest client hardware
IDB	instrument data base

IDD	interface definition document
IDD	instrument description document
IDIMS	Interactive Data Integration and Management System
IDL	interactive data language
IDL	interface definition language
IDR	Incremental Design Review
IEOS	International Earth Observing System
IOC	initial operational capability
IOS	Interoperability Subsystem
IP	Internet protocol
Ir	interim release
Ir-1	interim release-1
IRD	interface requirements document
ISCCP	International Satellite Cloud Climatology Project
ISS	Internetworking Subsystem
ITV	integration, test, and verification
IT	instrument team
IV&V	independent verification and validation
IWG	Investigator Working Group
JPL	Jet Propulsion Laboratory
KB	kilobyte (10^3)
Kb	kilobit (10^3)
Kbps/KBps	kilobit/kilobyte per second
KSA	Ku-band single access
L0-L4	Level 0 (zero) through Level 4
L0R	Level 0 Release
LAN	local area network
Landsat	Land Remote-Sensing Satellite
LaRC	Langley Research Center (DAAC)
LaRCNET	Langley Research Center Network
LAS	land analysis system

LDOS	Landsat Data and Operations System
LIS	Lightning Imaging Sensor
LOC	lines of code
L0R	Level 0 Release
LOS	line of sight; loss of signal
LSM	local system management (ECS)
LZP	Level Zero processing
M&O	maintenance and operations
MA	megabyte (10^6)
Mb	megabit (10^6)
MCF	metadata configuration file
MFLOPS	mega (millions of) floating-point operations (10^6) per second
MIPS	mega (millions of) instructions (10^6) per second
MIS	management information system
MISR	Multi-Angle Imaging SpectroRadiometer
MO&DSD	Mission Operations and Data Systems Directorate (GSFC Code 500)
MOC	mission operations center
MODIS	Moderate-Resolution Imaging Spectroradiometer
MODNET	MO&DSD Operational Development Network
MOM	mission operations manager
MOPITT	Measurements of Pollution in the Troposphere
MOPS	mega (millions of) operations (10^6) per second
MOR	mission operations review
MPE	Mission [to] Planet Earth
MR	Malfunction/Failure Report
MSS	Management Subsystem
MSFC	Marshall Space Flight Center
MSS	Management Subsystem
MSSU	Message Switching System Upgrade (Nascom)
MST	MODIS Science Team
MTPE	Mission to Planet Earth

MUI	Management User Interface
Nascom	NASA Communications
NCC	Network Control Center (GSFC)
NCCDS	NCC Data System
NCF	NSSDC Computer Facility
NESDIS	network Common Data Format
NGT	NASA ground terminal
NIU	network interface unit
NMC	Nascom Management Control Center
NMF	network management facility
NMS	network management subsystem (Ecom)
NOAA	National Oceanic and Atmospheric Administration
NOCC	Network Operations Control Center (DSN)
NOLAN	Nascom Operational Local Area Network
NSGW	Nascom Service Gateway
NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center (DAAC)
NSN	NASA Space Network
NSSDC	National Space Science Data Center
NTTF	NASA Test and Training Facility
O&M	operations and maintenance
O/A	orbit/altitude
OA	office automation
OC	operational capability
OCC	operations control center
ODB	Operational Database
ODL	Object Description Language
ORNL	Oak Ridge National Laboratory (DAAC)
ORR	operations readiness review
OS	operating system
OSDPD	Office of Space Data Processing and Distribution (also NESDIS/OSDPD)

OSF	Open Software Foundation
OTD	Optical Transient Detector
PA	product assurance
PA	performance assurance
Pacor	packet processor
PBL	product baseline
PDPS	Planning and Data Processing Subsystem
PDR	Preliminary Design Review
PDS	production data set
PGE	product generation executive
PGS	Product Generation System (ECS) (ASTER)
PGSTK	Product Generation System Toolkit
PI	principal investigator
PICF	Principal Investigator Computing Facility
PLNHW	planning hardware
PM	afternoon (post meridiem)
PM	EOS Afternoon Crossing Mission -- see EOS PM
PM	preventive maintenance
PMRD	preliminary mission requirements document
POCC	Payload Operations Control Center;
PoDAG	Polar DAAC Advisory Group
PODB	product order data base
POSIX	Portable Operating System Interface for Computer Environments
PROPS	Propulsion Subsystem (AM-1)
PR	Precipitation Radar (TRMM)
PRR	Preliminary Requirements Review
PS	Project Scientist
PSAT	predicted site acquisition table
PSCN	Program Support Communications Network
PSDN	Packet Switched Data Network
Q/A	quality/accounting

Q/L	quick look
QA	quality assurance
QC	quality control
QDS	quicklook data set
R&M	reliability & maintainability
R/L	return link
R/T	real time
RAID	redundant array of inexpensive disks
RAM	random access memory
RDBMS	relational data base management system
RFA	remote file access
RGS	receiving ground station
RICC	Remote Instrument Control Center
RMA	reliability, maintainability, availability
RMM	risk mitigation model
ROSE	Request Oriented Scheduling Engine
RPC	remote procedure call
RRR	Release Readiness Review
RT	real time
RTC	Relative Time Commands
RTM	requirements and traceability management
RTM	Requirements Traceability Matrix
RTS	relative time sequence
S/C	spacecraft
S/W	software
SA	single access
SAGE	Stratospheric Aerosol and Gas Experiment
SCDO	Science and Communications Development Office
SCF	Science Computing Facility
SCM	Software Configuration Management
SCN	specification change notice

SDOC	Science Data Operations Center
SDP	Science Data Processing
SDPF	Sensor Data Processing Facility (GSFC)
SDPS	Science Data Processing Segment (ECS)
SDS	science data standards
SDS	System Design Specification
SDSD	Satellite Data Services Division (also NESDIS/SDSD)
SDVF	Software Development and Validation Facility
SE	System Engineering
SE&I	system engineering and integration
SEF	Sustaining Engineering Facility (EDOS)
SEI	Software Engineering Institute
SEI&T	system engineering, integration, and test
SFE	Science Formatting Equipment (AM-1)
SI&T	system integration and test
SGI	Silicon Graphics Incorporated
SIRD	system interface requirements document
SITP	system integration test plan
SLOC	source lines of code
SMC	System Monitoring and Coordination (ECS)
SMMR	Scanning Multichannel Microwave Radiometer
SMS	Structures and Mechanisms Subsystem (AM-1)
SN	Space Network
SNC	Space Network Control Center
SNMP	Simple Network Management Protocol
SOCC	Science Operations Control Center
SORD	system and operations requirements document
SORR	Segment Operational Readiness Review
SPAN	Space Physics Analysis Network
SPN	shared processing network
SPOC	Science Planning and Operations Center

SPR	Software problem report
SPRHW	Science Processing Hardware
SPSO	Science Processing Support Office
SQA	software quality assurance
SRM&QA	Safety, Reliability, Maintalityinability, and Quality Assurance
SRR	System Requirements Review
SSA	S-band single access
SSF	Scripps Satellite Facility
SSI&T	Science Software Integration and Test
SSIM	Spacecraft Simulator
SSM/I	Special Sensor for Microwave Imaging (Defense Meteorological Satellite Program)
STDN	Spaceflight Tracking and Data Network
STGT	Second TDRSS Ground Terminal
SWCI	software configuration item
SWG	science working group
SWT	Science Working Team
T&C	telemetry and command
TB	terabyte (10^{12})
TBD	to be defined
TBR	to be resolved
TBS	to be specified
Tbyte	terabyte
TCP/IP	Transmission Control Protocol/Internet Protocol
TCS	Thermal Control Subsystem (AM-1)
TDRS	Tracking and Data Relay Satellite
TDRSGS	TDRS Ground Station
TDRSS	Tracking and Data Relay Satellite System
TGT	TDRSS Ground Terminal
TIROS	Television Infrared Observing Satellite
TMCF	team member computing facility
TMI	TRMM Microwave Image

TN	TDRSS network
TOMS	Total Ozone Mapping Spectrometer
TONS	TDRS On-board Navigational System
TOVS	TIROS Operational Vertical Sounder
TRMM	Tropical Rainfall Measuring Mission (joint US-Japan)
TRR	Test Readiness Review
TSDIS	TRMM Science Data and Information System
TT&C	telemetry, tracking, and command
U/I	user interface
U/L	uplink
UDP/IP	User Datagram Protocol/Internet Protocol
UT	universal time
UTC	universal time code
V&V	verification and validation
V0	Version 0
VAFB	Vandenberg Air Force Base
VIRS	Visible Infrared Scanner (TRMM)
WAIS	Wide Area Information Server
WAN	wide area network
WBDCS	Wide Band Data Collection System
WFF	Wallops Flight Facility
WKSHW	Working Storage Hardware
WOTS	Wallops Orbital Tracking Station
WS	working storage
WSGT	White Sands Ground Terminal
WTS	Wallops Tracking Station
WWW	World-Wide Web
X.500	OSI standard for directory services (207)
XSAR	X-band SAR
ZOE	zone of exclusion